THE ROMANCE OF *Scientific* BEE-KEEPING

ILLUSTRATED

KSHITISH CHANDRA DAS GUPTA

KHADI PRATISTHAN

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Published by
HEM PRABHA DEVI,
Khadi Pratisthan
15, College Sqr.
Calcutta.

SEPTEMBER, 1945.—2000.

Printed by
Charu Bhushan Chowdhury,
Khadi Pratisthan Press,
Sodepur, 24 Parganas.

PREFACE

Honey as a natural sweet is being used in India from time immemorial. The name *Madhuparka* indicates the place of honey in religious ceremonies. And then, there is a custom to give a few drops of honey to new-born babies. In the Ayurvedic system of medicine it is extensively in use. But what matters most is the production of honey as a human food, and to keep honey-bees for that purpose.

The domestication of bees is not new in India. Indian hive-bees have for ages been known to be kept in log and pot hives, and in the recesses of walls for the supply of honey. But the old method of extraction entails the destruction of the very bees that collect the nectar, and the combs which contain the honey. It cannot but be so. For, the bees have got to be smothered out, the combs cut out along with the eggs, grubs and honey, and squeezed to get the honey out.

But if the bees and their combs can be saved from this pitiable destruction, then the same hive may be made to yield honey year after year. Here, therefore, comes in the necessity of keeping bees in a scientific way to ensure the removal of combs without cutting them out from their place of attachment, making the bees store surplus honey exclusively in certain combs where the queen may not have access to lay eggs, dislodging the bees from the

combs without smothering them, and lastly extracting honey without squeezing out the combs. This is the modern method of bee-keeping, and it has been dealt with elaborately in the present volume. Scientific bee-keeping is rather new in India, and then, the beginners require very careful and practical guidance.

In the weekly paper *Rashtra-vani* of the Khadi Pratisthan, the author wrote certain articles serially on bee-keeping in 1939 and 1940 under the caption—'Honey and Honey-bee'. He also contributed articles on bee-keeping to the *Modern Review* (1939 and 1941), the *Prabasi* (1939), and the *Amrita Bazar Patrika* (1939 and 1940) of Calcutta. In the present volume all these articles have been incorporated after necessary changes.

The object of the author is to initiate the interested in the mysteries of the bee-hive. He attempts to take the beginner almost by the hand and lead him to approach the bee with confidence, to be familiar with this interesting little insect, and methodically proceed on to learn the art of bee-keeping.

Man's first association with the bee is with its sting, and the next association is with the honey. In the new method of bee-keeping, the bee-keeper knows how best to protect himself, and the fear of the sting goes out of consideration. Any way, the sting is not a serious hindrance or drawback to modern bee-keeping. On the contrary, the bees draw and sustain the abiding interest of the bee-keeper by their method of systemetic, organised and disciplined work. The bees

become friendly and objects of love, and the harmony between them rewards the bee-keeper, in the flow-season, with combs full of honey.

The present volume begins with the description of the composition and the properties of honey in the first chapter and ends in beeswax in the last, the intervening chapters being devoted to bees and bee-breeding including the capture of colonies from wild abode, the manipulation and the management of the bees, the production of honey and marketing. The swarming and its control have been fully described. The suitability of frame-sizes has been discussed. The possibilities of bee-keeping have been considered from the stand-point of cottage industry and commercial enterprise. Matters arising out of bees and bee-keeping have been incorporated within the limited bounds of the book.

In writing out the volume the author had always in his mind the mistakes made and the difficulties that he had to pass through when he first started keeping bees in 1936, and the necessary precautions have been pointed out in the book so that the mistakes may be avoided by others. The author now ventures to place the book in the hands of his readers having lived and worked with the bees for the last ten years. He hopes that the book will be found useful to beginners as well to apiarists who have already been in the enterprise.

Of the illustrations explaining the text of the book, some are photographs. The sketches have all been drawn specially for the book except of two skeps.

The author expresses his gratitude to Mr. H. Viswanathan who in the early days of the Sodepur Apiary showed the magic of his deft hands and the control he had over the bees. The author also expresses his grateful thanks to Mr. Rakhaldas Chakravarty of Dinajpur for the kind help he rendered in the early days of our Apiary.

Khadi Pratisthan,
Sodepur.
August, 25, 1945.

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CHAPTER I

COMPOSITION AND PROPERTIES OF HONEY

What is Honey and How it is Made :—Honey is a sweet thick fluid produced from nectar by honeybees in their hive. Bees collect nectar from flowers, carry the same to the hive in their honey-sac situated in the abdomen and then store it in the comb-cells. In the natural condition while in flowers, nectar is a thin transparent fluid. While in the sac and in the hive, nectar undergoes chemical change and turns into honey. In the conversion of nectar into honey the former is passed through a process of regurgitation, excess of water is evaporated by the warmth of the hive—the bees fanning the moisture out with their wings, and when the honey is ripe the cells are sealed by the bees with wax.

In India honey is known by different names in different provinces, the most common names being *Madhu, Madh, Mou* and *Shahad.* Honey usually gets the smell of the flower from which it is collected. For one drop of honey a bee is to visit more than a hundred flowers. Honey cannot be produced anywhere except in the laboratory of bees which is the beehive.

Pure and Fresh Honey :—Pure and fresh honey is sweet, delicious and palatable. It has got distinctive flavour and aroma peculiar to its own. It is a transparent and viscous liquid. The colour of honey ranges from glistening white or a very faint yellowish tint to dark red according to the season and kind of flower from which nectar is collected by the bees. It becomes opaque on granulation. The production of honey is seasonal being determined by blossoming of nectar-yielding plants and trees.

Nutritive Value of Honey :—Honey is a highly concentrated and nutritious food. The energy producing power contained in a pound of honey is known to equal 20 eggs or 4 pints of milk. Honey is predigested and therefore easily assimilable. It contains invert sugar, water, protein, and various mineral salts and other substances. The colour of honey bears a close relation to its mineral content. The deeper the colour, the higher the mineral matter contained in honey. It may thus be concluded that deep coloured honey has more nutritive value than the light coloured one. (Also see 'Chemical Composition of Honey', 'Legal Standard of Honey', and 'Honey and Glucose'.)

Honey as a Daily Food :—Among the various items of our food, honey claims a prize place. There is a custom in India to give a few drops of honey to the just born baby before any other food is given.

Children have a liking, rather a craving, for sugar. This is natural. Children are ever active except during sleep when they take rest. On account of

this active habit, movement of the body and exercise, they exhaust themselves. Consequently there is a natural demand in the system to replenish the deficiency thus caused and to add more. And this demand may be met well by honey instead of sugar. Excessive use of refined sugar causes ailments of teeth. But honey is a wholesome food and it does good to them. It works as a tonic.

Honey is good for young people and athletes. It is invigorating, To dispel fatigue and weariness, honey has no equal. It is a good item of food for persons having strenuous exertions in their daily work. Honey is appetising.

Honey is absorbed by the system without effort. It passes into the blood stream rapidly. When digestion is impaired due to disease or age, ordinary sugar can be profitably replaced by honey.

Among other mineral salts, honey contains iron and calcium. Iron is an important constituent of our blood. Its deficiency is indicated by paleness in sickly persons and invalids. Honey is good for them. Iron stimulates the functioning of the vital processes and is therefore very important. Calcium builds up the bone and makes the heart work properly. Therefore honey is the thing for children, adults and those who are far advanced in age.

If on account of excessive sweetness it becomes difficult to take honey as it is, then it may be taken diluted with cold or lukewarm water or milk, as suitable. It may be taken along with the various articles of food, namely, bread, biscuit, *Roti*, cake

and the like. Fried or puffed rice (*Moorhi*) and honey make a delicious tiffin.

It may generally be said that one tablespoonful of honey twice daily is quite good for adults, and for children one teaspoonful twice a day or as directed by the physician.

Medicinal Properties of Honey :—Medicinal properties of honey have been known in India from time immemorial. It is an excellent remedy for weak heart and wasting diseases. It quenches thirst and increases appetite. It is a mild laxative. It soothes cough, cold, sore throat and hiccup. It can be applied to scalds and bruises. It is a remedy for eye troubles.

In the *Ayurvedic* system of medicine the use of honey as a natural remedy for many diseases is known from a long time and is based on experience. In this system honey also figures as a common vehicle for a lot of medicines. The medicinal properties of honey and its use have been thoroughly dealt with in *Bhavaprakasha* from which the following *slokas* are quoted,—

मधुवर्गः

तत्र मधुनो नामानि गुणाश्च ।

मधुमाक्षिकमाध्वीक-क्षौद्रसारघमीरितम् ।

मक्षिकावरटाभृङ्ग-वान्तपुष्परसोद्भवम् ॥

मधु शीतं लघु स्वादु रूक्षं ग्राहि विलेखनम् ।

चक्षुष्यं दीपनं स्वर्यं व्रणशोधनरोपणम् ॥

सौकुमार्य्यकरं सूक्ष्मं परं स्रोतोविशोधनम् ।
कषायानुरसं ह्लादि प्रसादजनकं परम् ॥
वर्ण्यं मेधाकरं वृष्यं विशदं रोचनं हरेत् ।
कुष्ठार्शःकासपित्तास्र-कफमेहक्लमक्रिमीन् ॥
मेदस्तृष्णावमिश्वास-हिक्कातिसारविड्ग्रहान् ।
दाहक्षतक्षयांस्तत् तु योगवाह्यल्पवातलम् ॥ १-५ ॥

The food value and medicinal properties of honey depend on its purity and genuineness and it is only by the modern scientific method of bee-keeping that such honey can be got.

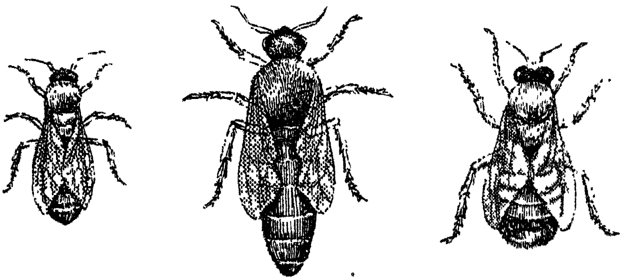
CHAPTER II

BEES AND BEE-KEEPING AT A GLANCE

Honey-Bee :—Honey-bee is familiar to us all. Many of us might have seen swarms of bees flying over our head, high up in the air, with the characteristic sharp buzzing sound, from one direction to another. Most of us must have seen bees humming from flower to flower in fruit and flower gardens, over pots of jaggery or tray containing sugarcandy in a grocer's shop.

Ants, bees and wasps live in communities. They belong to the order called Hymenoptera, that

Fig. 1. The Domestic "Indian Bee" (Apis indica), Enlarged.



Worker. Queen. Drone.

is, an order of insects having four membranous wings. Honey-bees being social insects live together

in the form of a colony. They are highly organised. Hive is their home where they work incessantly. There may be one or more combs in a hive according to the class of bees to which they belong. (See 'Honey-bees in India' in Chapter - 4).

Primitive Method of Bee-keeping in India :—Bees are common in India. The sight of bee-hunters collecting honey during the blossoming season is also common. In Bihar and United Provinces *Karoria* (*Karola* means hunter), *Nat*, *Natua* and *Kanjar* are the classes of people who generally hunt out bee colonies and collect honey. In some of the districts of Bengal they go by the name of *Boulay*, *Moulay* (honey-man) and *Madhu-bhanga*. These men get honey simply for the trouble of collecting it.

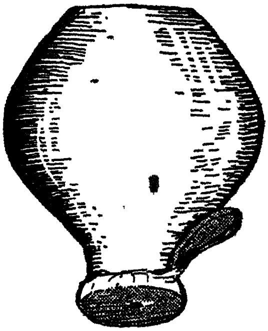


Fig. 2. A Pot Hive, Turned Upside Down.
These are kept suspended from the branches of trees and other suitable places for the bees to take shelter.

Artificial bee-keeping in a crude form has also been known in India for ages. Bees are kept in hollowed logs and in earthen pitchers turned upside down and tied to the branches of trees or hung up from the eaves of cottages. Sometimes pitchers are kept horizontally embedded in mud walls of dwelling houses with the closed mouth facing the inner side of the room. The bottom of the pitcher faces the outer side. A small hole is made at this

bottom for the entrance and exit of the bees. In the hills, small cavities are kept in the walls of houses for

Fig. 3. Decoy Hives.
One pot-hive is shown embedded in the mud wall of a dwelling house, and another may be seen hanging from the eaves. Villagers within a few miles of Calcutta still practise this primitive method of bee-keeping.

the bees to take shelter. Packing boxes also serve the same purpose. These are all decoy hives. During

the swarming period, swarms take shelter there, build combs and store honey. (Also see Chapter - 31).

This old method is still being practised in the hill districts of Northern India, in Mysore, Coorg and in several places in the Plains. It may be mentioned that even to-day bees are kept in a state

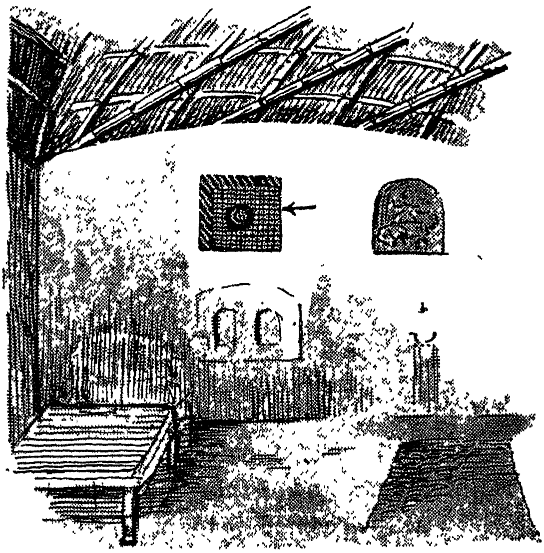


Fig. 4.
The mouth of the embedded pot (in Fig. 3) is shown here inside the room. The mouth is kept closed with a piece of cocoanut shell and then luted with mud. At the proper time, this end is opened for the removal of the combs.

of semi-domestication in earthen pitchers embedded in mud-walls and suspended from the eaves of houses in Sherakole, Amtala and several other

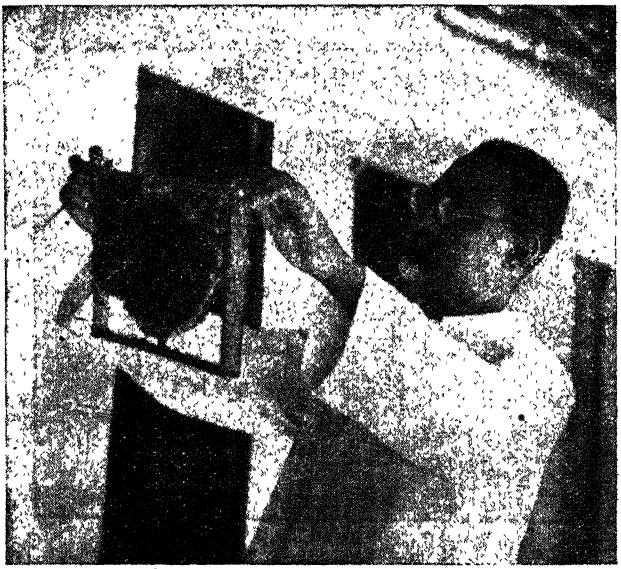
villages close by, in Diamond Harbour Subdivision, only about 25 miles from Calcutta to the south.

For the extraction of honey, bees are driven away by applying smoke to the hive and in the process a lot of them are burnt and choked to death. Combs are then cut out and honey extracted by squeezing the combs. Apart from honey, combs contain thousands of eggs and grubs. While squeezing the combs, all these are also crushed, and the juice thus squeezed out also gets mixed with honey. This method of collecting honey is not only primitive but cruel too. There is no export trade of honey thus collected. The whole quantity finds its way into villages and towns and is sold by grocers and other dealers who stock it during the season. On account of the crude nature of extraction the honey does not keep . It ferments in no time and becomes unfit for human consumption.

Modern Bee-keeping :— Bee-keeping is practised now-a-days on scientific lines and honey extracted without killing bees and grubs or destroying the combs. Bees are accomodated in artificial hives where they live comfortably within easy reach of the bee-keeper for examination and extraction of surplus honey, after keeping sufficient honey in the combs for the bees.

Artificial Hive :—The main feature of the artificial hive is the removable frame. Bees are made to build combs in wooden frames accomodated in a box. Combs can be taken out with the adhering bees, examined and placed in position again in the hive. Honey is

very heavy and the comb is frail being made of wax. It is the natural instinct of the bees to store honey in the upper part of the comb where it is fixed to its natural support so that the comb may not sag down by the weight of honey. This instinct of the bee has been taken advantage of in making the artificial hive.



A Comb Under Examination.

Usually there are two chambers in a hive, one upon the other. The lower chamber is for brood rearing, while the upper chamber is for exclusive storage of honey where no eggs are laid. Cells of the brood comb in the lower chamber also contain honey here and there and also in one strip of 2 to 3 inches in the

upper part of the comb for the needs of the bees. There are methods of getting exclusive honey from the lower chamber also, by shutting out the queen with the help of an excluder so that she may not lay eggs in the combs thus excluded.

For the extraction of honey, combs are taken out, bees removed by jerking them off, combs uncapped

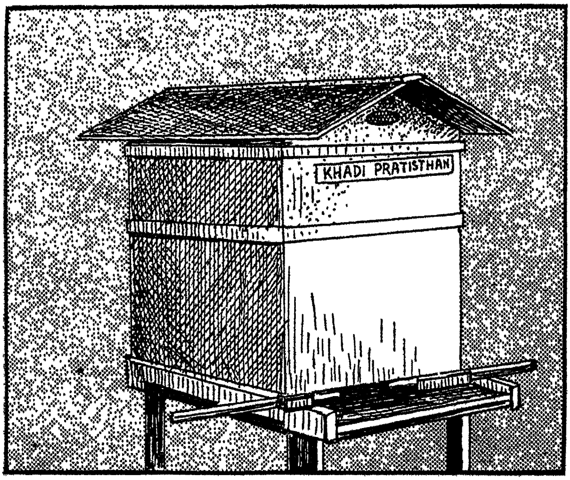


Fig. 5. A Modern Hive.

with the aid of a cap-cutting knife, and honey extracted with the aid of a centrifuge called the honey-extractor. After the extraction is over, the empty combs are again returned to the hive and the bees begin to collect honey again as usual. And this continues till the honey flow season is over. (For the 'Advantages of Artificial Hive' and detailed

description of 'Hive' as also other bee appliances, see Chapter-8).

Bee-keeping in Other Countries :—Bee-keeping on modern lines is an established industry in America and in European countries. America is ahead of all others where it is being practised for near about

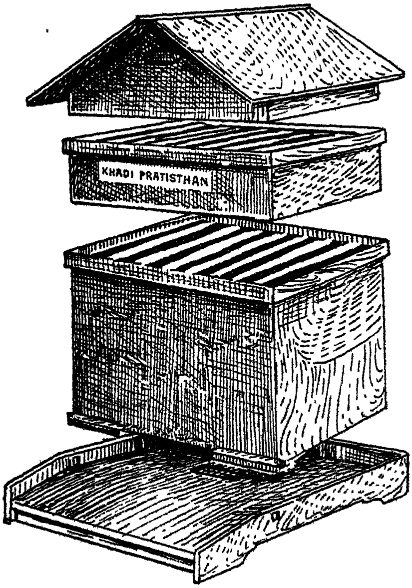


Fig. 6. Modern Hive, Showing the Parts.

100 years. In England it is being carried on for over 50 years.

England produces honey for her own consumption and gets supplies from other countries as well. The main sources of import of honey into England are the British West Indies, New Zealand, Canada,

Australia, United States, Chile, Russia, Cuba, San Domingo, the Netherlands, Hayti and France. There are also other countries which export honey though their quantity is comparatively small.

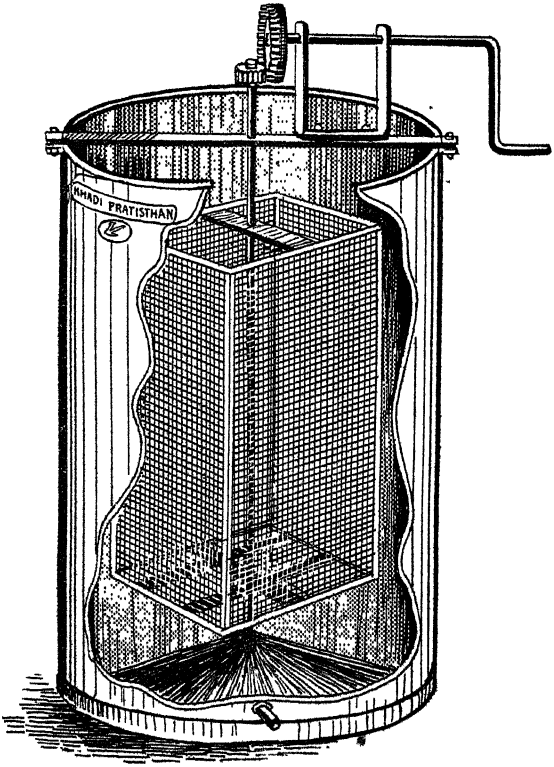


Fig. 7. Honey Extractor.

In the 'Report on the Marketing of Honey and Beeswax in England and Wales', published in 1931, we find that the value of honey produced there at

that time, approached £200,000 annually. Yet it was considered as a less important branch of rural activity. There were about 20,000 bee-keepers in England and Wales in 1925 with about 70,000 bee colonies. In 1929 the total number of colonies swelled upto 100,000, bee-keepers numbered 23,500, and the total weight of honey crop was 34,300 cwt. Over and above their own production the average annual import approached 100,000 cwt. of which about 10% was re-exported.

The above figures are of a country where the annual consumption of honey is about ½ lb. per head. In Canada the average consumption is 2 lbs. per head per annum. It is higher in New Zealand. Among the exporters to England, U. S. A. stands first and New Zealand second. These figures alone, without going into the figures of the other countries, will give one an idea as to the possibility of bee-keeping and the position of honey in the world market as a foodstuff and as an agricultural produce.

In America and in European Countries bee-keeping is practised methodically both on commercial and cottage scales. Researches were made and the whole thing has been brought to a standard. There are bee-keepers' associations that look after the grading and marketing of honey, and help bee-keepers with advice and information. There are firms which keep and supply bees, queens, hives, comb-foundations and all sorts of outfits and appliances. One can purchase live bees by weight like other commodities, a swarm or an established

colony by rail or a single queen by post. For honey there are wholesalers and retailers, brokers and agents, exporters and importers. Marketing has been organised and advertising concerted. There are laws against adulteration and in several countries there are statutory grade standards of honey. (See 'Legal Standard of Honey'). There are books on bee-keeping dealing with the manipulation of bees and combs, extraction of honey and all matters relating to bee and bee-farming.

Modern Bee-keeping in India :—Bee-keeping is highly fascinating. Bees may be kept in cities, towns and villages where there are nectariferous plants and trees in the locality and within a close range round about. Bees may be kept for producing honey for one's own domestic use and also for supplementing income by selling the surplus.

Bee-keeping on modern lines is being practised in India these days, but we may not compare it with what is being done in other countries. Some of the Indian States and Provincial Governments have taken up the matter and their efforts in this direction are highly commendable. The number of apiaries owned by individual bee-keepers and institutions is happily on the increase.

Bee-keeping in Indian States :—Modern bee-keeping in Travancore dates as early as from 1917. In the "Brief Memorandum on Bee-keeping in Travancore", dated Trivandrum, 19th March, 1935, we find that in 1931 there were more than 1000 apiarists in Travancore, each owning one to ten hives,

of whom 689 were keeping bees as an additional means of income. Since then the number of hives has exceeded 10,000. In the villages of South Travancore alone, there were more than 3000 bee-colonies in modern hives, reared by the villagers.

In the foreword to the booklet on bee-keeping (Bulletin No. 10, 1938) published from Bangalore by the Department of Agriculture, Mysore State, we find that steady work in introducing bee-keeping in modern hives among the ryots was started there in 1927. With a view to demonstrate the possibility of the educated unemployed taking to bee-keeping as an occupation and to make people more bee-minded, six apiary centres had been started by the Department with 25 colonies each. The Department is also engaged in inducing people having pot-hives to change them over to modern improved hives.

Coorg, lying on the Western Ghats in South India, possessed over 2500 modern hives in 1939 distributed all over the place. Work was first started with 40 hives and in three years it attained that figure.

Efforts by Provincial Governments :—Attempts at modern bee-keeping are also being made by some of the Provincial Governments. At the instance of the Madras Government an apiary was started by the Government Entomologist at the Agricultural College, Coimbatore, in 1931. From a report of the seventh annual 'Honey Week' celebration held at Coimbatore in May 1944, published in the 'Indian Bee Journal' (July and August issue, 1944, page 143), we find that there are 10,267 hives working in the Presidency of

Madras. Recently the Provincial Governments of the Punjab, the United Provinces and Bombay have taken up the craft and trying to popularise it. In the Punjab, there are two Government bee-farms. One is at Nagrota (Kangra) and the other which was at Raison (Kulu) has since been shifted to Katrain (Kulu). In U. P., the Government apiary is situated at Jeolikote (Nainital). In Bombay, the Government bee-farm is located at Ganeshkhind Fruit Experiment Station, Kirkee.

Efforts by Organisations and Individuals :—The all-India Village Industries Association maintain (1939 Report) one apiary at Wardha in the Central Provinces and have started, with the aid of Government grant, seven more apiaries in the said province. In Orissa they have an apiary at Bari-Cuttack. In Bihar they have established two apiaries, one at Muzaffarpur and the other at Brindavan. In Karnatak (Bombay) they have an apiary at Honavar.

In Bengal, the Khadi Pratisthan has a central apiary at Sodepur near Calcutta and three branch-apiaries in the mufassil.

It is not intended to give here an exhaustive list of apiaries that may be found to-day established all over India. But it may be pointed out that apart from apiaries run by other institutions and organisations as well, there are lots of modern apiaries well kept and managed by individuals in different places in India.

Value of Bees in Agricultural Country :—India imports honey to-day. She can stop it by taking

to modern bee-keeping earnestly. The quantity of annual import by weight and its value could not be ascertained as no statistics are kept on this head specifically. It is a matter of deep regret that India being an agricultural country and having luxuriant growth of forests and nectariferous plants and trees should have no place in the world honey-market, and that she should allow the enormous quantities of nectar produced in the cultivated lands and in the wild plants to be wasted away every year instead of converting it into national wealth.

Then again, apart from producing honey, the immense help rendered by the bees by proper pollination of flowers resulting in increased production of fruits and other agricultural crops, cannot be overestimated. (For 'Pollination', see below). The value of bee-keeping in an agricultural country of the size of India is beyond computation. Bees are there, but we do not know how to keep them properly and get pure honey for our own use and for the market far and near. It is difficult to get proper appliances and expert advice. The bee-keeper here is to make his hive according to his own ideas and choice, and as for appliances he shall have to manage things as best as he can. But difficulties as these are unavoidable for an industry while it is in the making. Of late, some of the bee-keepers have begun manufacturing beehives and appliances and making them available to others.

Bee-keeping has become natural in those countries where it is being practised for long continued years.

So it must be with us in India. Being new, it may take a little time and require some effort, but we must be diligent enough to stick to it and carry it on to success. We should know that even a handful of bees is also an asset, and that a bee-keeper by proper care and management can utilise it profitably.

Pollination : Value of Bees in Agriculture and Fruit-gardening :—That bees render invaluable service, by pollinating fruit-blossoms and flowers in the production of better fruits and seeds, has already been stated. In order to get a comprehensive idea, let us try to understand the *flowering plant*, and the structure and function of the flower.

The sweet liquid nectar is secreted in parts of flowers by special glands called Nectaries. The petals of flowers are often marked with spots, lines or grooves called Nectar Guides so that insects visiting flowers during the day, may easily find out the place where the nectar lies. And we know, bees gather this nectar and turn it into honey, round which the narrative of bee-keeping is woven.

There is urge in the living organism to reproduce its own kind so that species may not die out. Flower is the organ of reproduction of the flowering plants. Flower produces seeds, and seed contains food material and the germ of future plant. The Stamens and Carpels are responsible for the production of seeds. Stamen is the male organ which produces pollen. Pollen-grains are male cells. Carpels are the component parts of the Pistil. Pistil is the female

organ in the centre of a flower, enclosed in which lies the female cell. Pistil consists of three parts—the Stigma, the Style and the Ovary. Inside the ovary is Ovule, which is the female cell. Ovary may contain a single ovule or a number of ovules. Ovule develops into seed. But this development cannot take place unless the male cell and female cell meet, and fuse subsequently. The first step to this is the carrying of pollen-grains from stamen to stigma of the pistil. This transference of pollen from stamen and bringing the same in contact with the stigma, is Pollination. Next step is Fertilisation, which is the fusion of the male cell with the female cell that results in the production of Seed. And the ovary, when matured, is called the Fruit.

When stigma gets pollen from the same flower, the process is called *Self-pollination* or Autogamy. It is *Cross-pollination* or Allogamy when pollen reaches stigma from another flower on the same plant or from another plant of the same species. Cross-pollination gives better result than self-pollination. According to the structure of flower and as to the means how pollination is effected, flowers are divided into different groups.

In cross-pollination agents are necessary for carrying pollen. These agents are air, water and insects, and according to the nature of this agency, flowers are divided into three principal groups. Flowers that require insects to effect pollination are called Entomophilous or insect-flowers. They attract insects by various means such as colour, odour, and

food in the form of nectar and pollen. Entomophilous flowers are again grouped into several classes according to the means employed to attract, and to the devices in the flowers to entrap insects. Some offer pollen exclusively; some offer nectar, exposed or partially or fully concealed; some offer pollen and nectar both; and then, some employ other methods. There are various insects that help pollination more or less, and of the pollinating insects, the honey-bees are highly specialised and most helpful.

The dazzling colour of the flowers, the nice scent, the sweet nectar attract bees. They visit flowers and gather both pollen and nectar. They restlessly fly about from flower to flower in their usual course of daily visit in search of food and thus in their process of collection, transfer pollen to stigmas of other flowers and help cross-pollination. Here we find flowers and bees are interdependent. Bees depend on the flowers of plants for nectar and pollen, and plants depend on bees to visit flowers for their reproduction.

Instead of depending, therefore, on unknown and uncertain agents for precarious pollination, it is desirable to own a few colonies of bees and ensure better pollination. That will amply repay the trouble or the interest taken in keeping bees under modern method. It will provide proper fertilisation which ensures better development of the ovules producing seeds, gives impetus to the growth of the ovary maturing ultimately to produce the fruit, and secures maximum harvest—the yield of honey becoming an extra income then. When pollination is

imperfect, most of the flowers wither away without becoming productive, the final crop falls short of expectation to the great grief of the producer. Modern bee-keeping has come to be very much appreciated in other countries from the stand-point of this better harvest alone, leaving aside the honey yield.

CHAPTER III

ACQUAINTANCE WITH THE BEE

A prospective bee-keeper must be hard working, intelligent and inquisitive. He has got to be bee-minded. He must give up the idea, if any, that bees require no attention. He must not expect others to look after his stock. He must not commence bee-keeping with the idea that his part is to get a hive, house the bees in it and the rest will be for the bees to do and present the bee-keeper with bottlefuls of sweet honey. No—it is not so. Successful bee-keeping is an art. It requires knack and experience acquired through work and close study of the nature and habit of the bees. Once the thing has a go and established itself in the soil, it will be easy for the generation that will be coming after us, to do it and attend bees without the least effort, along with other daily routine work. Babies will then see that their cottages are humming with bees and will get accustomed to the bee atmosphere.

Artificial hive is nothing if it does not give the bees better accomodation than the hollow of a tree trunk or an abandoned earthen pot, better protection, better comfort and ease to work on. And the bee-keeper is no good and has no business to dislodge the bees from their natural abode if he cannot assure proper comfort, look after their needs in time and

protect them from their natural enemies which they cannot do properly if left to themselves as in the wild abode. (See 'Enemies and Diseases of Bees', Chapter - 7). Attend your bees, lend your services to them, arrange so that they may have sufficient honey in the combs for themselves and the young ones that will be emerging out of the cells, and see to it that they are working with ease and comfort, merrily. Bees in their turn will present you with surplus honey—delicious and palatable, full of aroma, in transparent beautiful colours.

A beginner shall have to acquaint himself with the bee family i. e. the members of the colony, namely, a few thousand workers, some drones and the queen. The queen can be easily distinguished from the rest of the members by her size and majestic movement. She is a fully developed perfect female bee, whereas the workers, though females, are not fully developed and are sterile. This is on account of the difference of food given to them by the nurse-bees at the time of rearing and on account of the difference in cell in which they are reared. The drones are males. (See Chapters - 5 and 6, which deal with 'Bee Colony' and 'Development of Egg').

A beginner must know the parts of the artificial hive, i. e. the box in which bees are housed and the removable frames in which bees are induced to build combs for brood and honey. He must learn the handling of bees and frames, extraction of honey and wax and other things relating to bees and their keeping. He must be able to capture bees from

their natural abode and hive them. Lessons from a practical bee-keeper by attending demonstrations and lectures, apart from instructions from text books, are helpful to the beginner.

On a small scale and as a spare time occupation a start with a couple of colonies will be good. The number should be increased as one acquires experience and becomes confident in handling more. One must go forward but proceed slowly and cautiously.

Limbs of the Bee :—To understand the bee one must know the various parts of its body and their

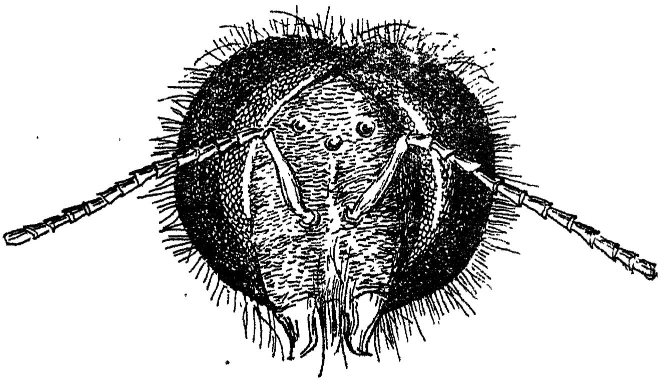


Fig. 8. Head of Drone (Enlarged).

functions. The body of the honey-bee has three distinct sections. These are (1) the Head, (2) the Thorax or chest and (3) the Abdomen.

(1) **Head** :—The head contains two big compound eyes, one on each side, made up of a number of lenses, and three small eyes in the front called simple eyes, a pair of feelers, a pair of jaws and a tongue

covered in a sheath. The compound eyes of drone are bigger than those of the worker. The worker

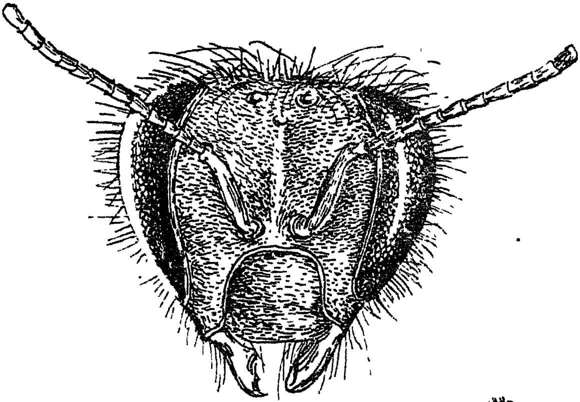


Fig 9. Head of Worker (Enlarged).

gathers nectar from flowers with the aid of the tongue, but the drone cannot.

(2) **Thorax**—All the organs of locomotion are attached to thorax. It bears three pairs of legs and two pairs of wings. One pair of legs is in the front, then comes the intermediate pair of legs and the first pair of wings, and then the hind pair of legs and the second pair of wings. The hind pair of legs of the worker has a special function to perform which is to carry pollen. There are two 'pollen-baskets' on the two hind legs. The

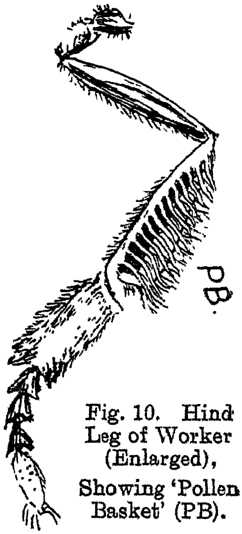
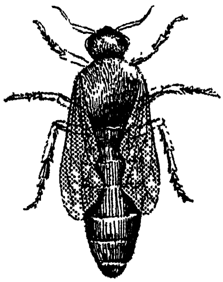


Fig. 10. Hind Leg of Worker (Enlarged), Showing 'Pollen Basket' (PB).

baskets are fringed with stiff hairs. The pollen is packed in the basket having been gathered from flowers, and carried to home for storage. The drone and the queen have no pollen baskets. (See 'Food of the Bee,' Chapter - 6).

The wings lie folded over the abdomen and the two pairs act as a single pair when flying. The wings of the drone are large, and those of the workers short. The wings of the queen are shortest, and cover only about half of the abdomen.



Queen.

(3) **Abdomen**—The abdomen is joined to the thorax. It is the largest section of the body. The abdomen of the queen is longer and more pointed. It is only the workers that can secrete wax through wax-plates underneath the abdomen. (See 'Beeswax', Chapter - 43).

The *honey-sac* is situated in the abdomen. The worker at her will can admit the contents of the sac into the stomach or transfer it to comb-cells.

The abdomen of the worker has at its extremity the *sting* which is straight. The sting is the weapon of the worker bees to fight enemies. Attached to the sting is the poison-sac containing a fluid which is discharged into the wound after the sting is thrust. The more the bee is angry, the more the poison is injected. With the bees the sting is of great importance howevermuch we may regard it as undesirable, for it is the only weapon

by which they can try to save the colony from depredation.

The queen bee also possesses the sting which is slightly curved but she is not known to have stung a bee-keeper or any human hand even when roughly handled. It is only against a rival queen that she uses her weapon. The drone has no sting.

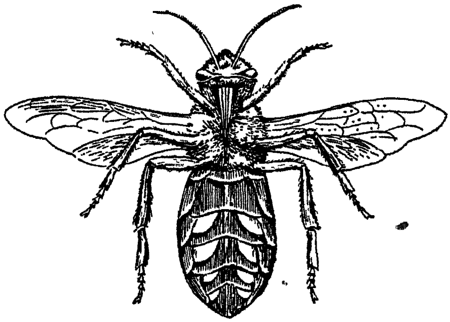


Fig. 11. Underside of Worker Bee,
Showing Wax Scales (Enlarged).

The worker after thrusting the sting tries to escape and withdraw it by circling round upon the wound. The sting once thrust cannot be withdrawn straight away as it is barbed at the end and gets entangled in the part stung. Usually the worker, in her hurry, tears herself away leaving the sting behind as also the poison-sac and the gland. Deprived of the sting the worker dies in less than three hours. Herein lies the difference between the sting of the worker and that of the queen apart from their difference in shape already referred to above. The queen's sting is practically barbless and therefore she can

remove it without in any way injuring herself after stinging a rival.

When the worker escapes leaving the sting in the wound, the poison goes on to be pumped there automatically. A careful look at the time will show that the muscle round the sac is contracting and expanding, thus injecting the poison.

The sting should be scraped out at once with the aid of a penknife or sharp nail. More poison will be injected if the sting be allowed to remain on the skin or pressed carelessly while scraping out. If the skin is barely touched by the sting causing even a slight prick, a burning sensation will begin at once, the spot will become hot and swelling will begin. The bee-venom is a clear syrupy fluid. It has a particular smell which irritates the bees very much.

The venom of the honey-bee is now considered to be akin to snake poison. In Root's ABC and XYZ of Bee Culture there is a quotation from a paper published in the American Journal of Physiology (1930), regarding the nature of this venom. The paper was from the Division of Experimental Surgery and Pathology, Mayo Foundation, Rochester, Minnesota. The following lines from it will be of interest to note,—

> "In general, the venom of the bee may be described as a violent endothelial poison and a marked stimulant of smooth muscle; it is comparable in these respects to histamine.......
>
> "......the venoms of the honeybee and of the rattlesnake apparently have similar physiologic

properties. It is remarkable that the venom of the honeybee should be similar to that of the rattlesnakes. Wasps, hornets, scorpions, mosquitoes, nettles, and other forms, whose sting is followed by a similar reaction, possibly will be shown to possess venom with similar properties."

Thus, after all, whatever the nature of the bee-venom might be, we need not unnecessarily be frightened either of the sting or of the venom. And it may safely be assured that the sting of the Indian Bee (*Apis indica*) is far less irritant and painful than the sting of the common yellow wasp.

The poison is acid in reaction. Application of ammonia-water stops the burning sensation at once, but the pain continues and the swelling goes on increasing. Hot compress relieves pain to a great extent. The poison does not affect all persons with equal intensity, and one becomes less susceptible to pain if stung frequently.

That the smell of the bee-venom irritates the bees has already been said. It makes them so furious that it becomes impossible to approach the bees with the smell on. The first thing to be done after the removal of the sting is to wash the wound with water and then apply dilute ammonia. Ammonia will not only hide the smell of the venom but will also relieve the burning sensation. Lime-water or a lotion of Soda may also be used but they are not so effective as the other. Onion (Pyaj) is also helpful. Take a bulb of onion, slice off a portion and then apply the moist part on the wound. It will both hide

the odour and relieve pain. Juice of the leaves of *Vishahari*, a plant of magenta colour commonly found as ornamental hedges in flower gardens along the paths, may be used. Leaves of *Genda* (Indian Marigold) may be rubbed over the wound to hide the smell. Honey may be applied for the same

Fig. 12. Bee Veil,
Protecting the Face.

purpose. If nothing can be found ready at hand then rub on the wound leaves of any weed.

The sting should be considered from the standpoint of the bees and its utility appreciated as a device to fight out enemies for the preservation of the colony. We should accept it without regret but at the same time learn the art as to how best it could be avoided, for, there is no virtue in

getting a sting. Careful handling of bees is all that is necessary. By use of the veil and gloves, both face and hands can be protected. (See 'Veil and Gloves' in Chapter-8.) The sense of security will help the beginner to handle bees with more confidence.

Bees can both fly and walk. They can fly backward also. When a hive is shifted to a new place, bees after circling round it, will be seen flying away backward with the head facing the hive, carefully noting its position and other landmarks near about. In the case of an established colony, bees after coming out of the hive in order to visit flowers, dart into the air and vanish so quickly that it becomes difficult to follow their course. Their rate of flight at the time is between 15 to 20 miles per hour. When they come back laden heavily with pollen in the hind legs and honey in the sack, their speed diminishes, varying between five and twelve miles. They can be seen coming in a zigzag course or in a wave, flying up and down, as if dancing.

They can stop suddenly even when flying at a top speed. During the honey flow season when they thus come from the field and are in a hurry to discharge their precious load, they often slip their grip on the alighting board which results in somersault.

CHAPTER IV

HONEY-BEES IN INDIA

Classification of Bees in Old Days :— From the very early days honey used to be classified in India according to the variety of the bees that collected it. In *Sushruta-Sanhita* we find a description of eight varieties of honey and their properties. Bhavamishra in *Bhavaprakasha* gives the same description with the names slightly rearranged, thus,—

मधुभेदाः

माक्षिकं भ्रामरं क्षौद्रं पौत्तिकं छात्रमित्यपि ।
आर्घ्यमौद्दालकं दालमित्यष्टौ मधुजातयः ॥६॥

Of the above eight varieties of honey, the first seven are collected by bees, and the last, i. e. *Dal-madhu* is found on the leaves of trees. By this classification we directly get here at least seven varieties of honey-bees known in those days. After having thus classified honey, Bhavamishra goes on stating the properties of each variety with the full description of the bees that collected the same. We quote below only the description of those bees against each class of honey as stated by him so that we may compare the same

with the bees as are now found. Here is the description,—

(1) Makshik-madhu : collected by *Makshika,* a brown (*kapil*) coloured big bee. (This may be the 'Rock Bee'). (2) Bhramar-madhu : collected by a class of small *Bhramara* having six legs. (This may be the 'Bumble-bee'). (3) Kshoudra-madhu : collected by little bees of brown colour named *Kshudra.* (This may be the 'Little Bee'). (4) Pouttika-madhu : honey stored in the hollow of tree-trunks by a class of black small bees of the size of mosquito which are often very painful. This bee is called *Puttika.* (This may be the 'Dammar Bee'). (5) Chhatra-madhu : collected by a class of bees called *Barata.* These are of brown and yellow colours, and are often found in the forests of the Himalaya. They build combs of the shape of umbrella. (6) Arghya-madhu : collected by a class of bees called *Arghya.* These bees are of yellow colour and have sharp mandibles. (7) *Ouddalaka* : honey collected by a class of bees of small size having brown colour. They very often build combs in the ant-hills, and the yield of honey is not much. (This may be *Apis indica,* the common 'Indian Bee'). (8) Dal-madhu : honey found deposited on the leaves of trees. (This may be "Honeydew" honey, for datails of which see Chapter - 15).

Honey-bees As Now Classified :—We have seen above the different kinds of bees as stood classified in the early days. But bees that are generally found

now-a-days and draw our attention are four in number, namely, (1) the Rock Bee (*Apis dorsata*), (2) the Indian Bee (*Apis Indica*), (3) the Little Bee (*Apis florea*), and (4) the Dammar Bee, a tiny insect smaller than the Little Bee, belonging to the genus *Melipona* or *Trigona*. They are of a type quite different from the other three mentioned.

(1) **The Rock Bee** :—The Rock Bees build huge combs on rocks, on terraces and cornices of buildings

Fig. 13. Rock Bee Colonies, on the branches of a tree.

and high up on the branches of trees. They build one single comb for a colony. Rock Bees are the greatest honey yielders, but they are very ferocious. They do not brook disturbance and cannot be domesticated. (See Chapter - 30).

(2) **The Indian Bee** :—The Indian Bees live in covered places, in dwelling houses, in abandoned

rooms, in cavities under the ground, in the hollows of tree-trunks, in the crevices of brick built and mud walls, in abandoned tin canisters, boxes, earthen pots and the like. They build several parallel combs side by side, the number of which is usually seven. In some places they are called *'Sat-pati'*. From centre to centre the combs are built at about an inch apart.

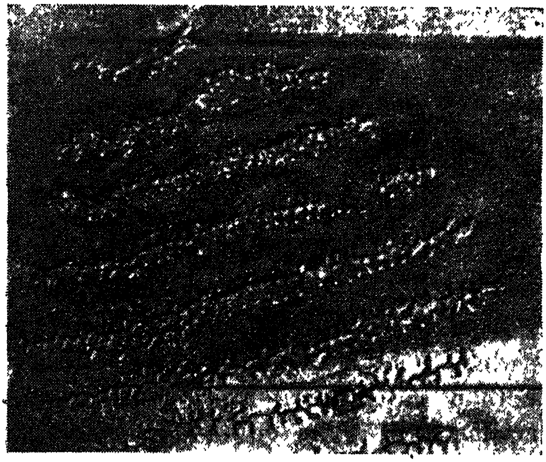


Fig. 14. Marks of the eight combs of one wild Indian Bee colony which was in a tin canister. Combs were cut out for transferring the colony to a modern hive.

The total width of 8 combs of one particular wild colony in the Plains, was found to measure 8 inches over-all. Honey yield of this variety is next to that of the Rock Bee. This is the only Indian variety of bees that can be hived artificially, and are not so ferocious as the Rock Bee.

Different Types of 'Indian Bee' :—There are two types of Indian Bees,—the Plains type and the Hill type. They differ in colour, size, temper and honey collection. The colour of the queen of the Plains type ranges from orange yellow to deep tan and that of the Hill type from deep ash mixed with violet tint to jet black. The workers of the Hill type are bigger in size and darker in colour than that of the Plains type. The colour of the abdomen of the worker of the Plains type ranges from dull brown to dark brown with bands the colour of which also differs in shade.

Bees of the Hill type are very shy. They creep away from comb with a buzz and flapping of wings, leaving the brood, at the slightest jerk or a slight puff of air from mouth. The workers of the Plains type will not move away easily from the comb, and at times will resist a full blow of air. The Plains type of bees seem to be a bit irritable, but the Hill type of bees when brought down to Plains become more irritable than the former. They calm down slowly when acclimatised. The queen of the Hill type is more prolific and the worker a better honey gatherer.

(3) **The Little Bee** :—The Little Bees build one single comb for a colony in bushes, on the branches of small bowers and sometimes even in dwelling houses. These bees do not brook disturbance, and it is difficult to domesticate them. The size of the Little Bee is smaller than that of the Indian Bee and can be easily distinguished by the white shining bands on their black abdomen. They do not yield much honey.

(4) **The Dammar Bee** :—The Dammar Bees build ombs in the crevices and in the hollows within trees with gums and other resinous substances collected from plants, and their method of construction is also different from that of the others. Their collection of honey is exceedingly small. One of its Indian name is *Poye*, and the resinous substance that it yields is known as *Pwe-nyet.*

As to its use we find,—"The resinous product collected and used by the bees in making their nests is called '*pwe-nyet*' by the Burmese, and after boiling in water and mixing with earth-oil or petroleum, it is largely used for the caulking of boats. The right of collecting '*pwe-nyet*' is sold by the Local Government in Burma and Tenasserim yearly, and forms one of the sources of revenue under Minor Forest Pruducts." (Watt's Commercial Products of India).

Which Bee-to Keep in Artificial Hives :—Honey-bees that can be hived artificially are called 'Hive-bees,' and the 'Indian Bee' (*Apis indica*), description of which has already been given above, is the only variety in India that can be hived and domesticated profitably. Wild colonies of this type of bees are abundant in India and can be procured in any number easily. A little search and enquiry in one's own neighbouring areas will give the clue as to where such a colony can be found.

CHAPTER V

BEE COLONY

Queen lays egg in the cell, egg hatches into larva. It is the first stage of the insect after being hatched from the egg. It is helpless, being without eyes, legs or wings. Larva or grub when fed, transforms into pupa. Pupa is the sleeping stage from which the full grown bee emerges out. (See 'Development of Egg' in Chapter - 6). The bee colony is composed of a queen, a large number of female bees called 'workers' and some drones. Drones are usually raised just before and during the swarming time when new queens are reared. Drones may not be present during the rest of the year, and if at all, only a few.

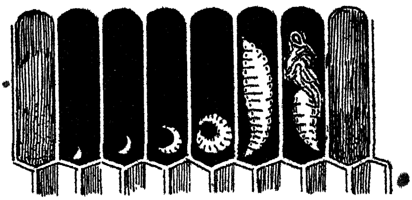


Fig. 15. Egg and the different stages of its development upto Pupa.

Functions of the Members :—Queen's function is to lay egg and nothing else, the rest is being done by the workers. Drone's function is to inseminate the virgin queen. Drones are tolertated in the hive for that consideration only. They cannot collect

nectar but live on honey stored in the cells by the workers. They are killed or maimed and driven out of the hive when the swarming period is over.

By 'bee' is meant the female bee that we find busy inside the hive and on the flowers. Female bees comprise the main population of the colony. The responsibility of working the colony lies with them, and so they are known as 'workers'. According to the nature of work they are to perform, workers are classified as 'nurses' and 'foragers'. (See 'The Worker' in Chapter - 6, and also 'Functions of Young Bees' under 'Snelgrove's Method' of Swarm Control, in Chapter - 25). Foragers go out, visit flowers, gather pollen and honey, as also water. They gather *propolis* for binding the combs to the support from which the comb is drawn out, and for mending cracks. Propolis is a sticky resinous substance gathered from various trees and plants.

The nurse bees feed the grubs with a special food called '*Royal-jelly*'. This royal-jelly is believed to be a secretion from the "lateral pharyngeal glands" of the young nurse bees, and supplied through mouth. It is a thick opaque gelatinous substance and very much resembles thick condensed milk in appearance. It is given to grubs just hatched.

Royal-jelly is also called 'Bee-milk'. It always remains moist in the cell. If a small quantity of it be removed from a cell with a penknife, the upper layer will soon dry up in coming in contact with air. It tastes acid on the tongue. The acid reaction may also be tested with Litmus paper. The jelly

dries up when kept exposed for a long time, and the colour changes to brown. Queen cell having fresh grub contains a lot of royal-jelly, and it can be easily examined by removing such a cell from the comb whenever opportunity occurs.

The workers keep guard near the entrance of the hive and defend the colony from enemies. They mend

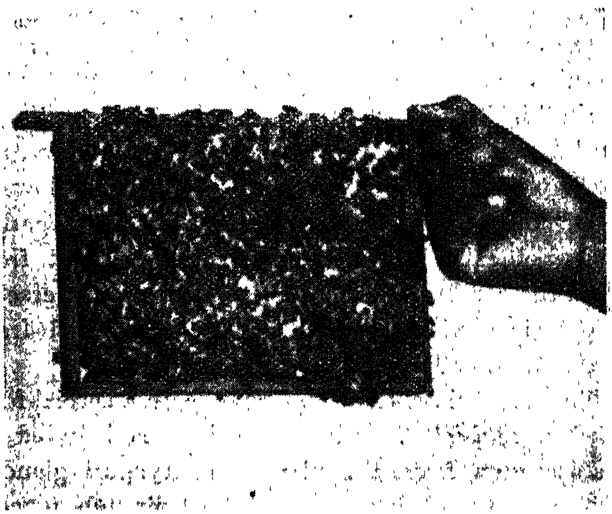


Fig. 16. A Typical Brood Comb
With Bees Thickly Adhering.

combs, remove dirt and refuse matters, dead bees or dead grubs if any, and keep the hive neat, clean and tidy. They rear queens during the swarming period (see 'Honey Season and Swarming,' in Chapter - 14), and also when a colony, for any reason, becomes queenless. (See 'Queenlessness' in Chapter - 22).

The workers secrete wax and build combs. They maintain hive temparture by adhering to the combs and also cover them up for the hatching of eggs. They fan in cold air by quick and continuous flapping of their tiny wings when necessary. They cling together in the hive in a chain forming a long cluster. By thus hanging silently they increase heat within

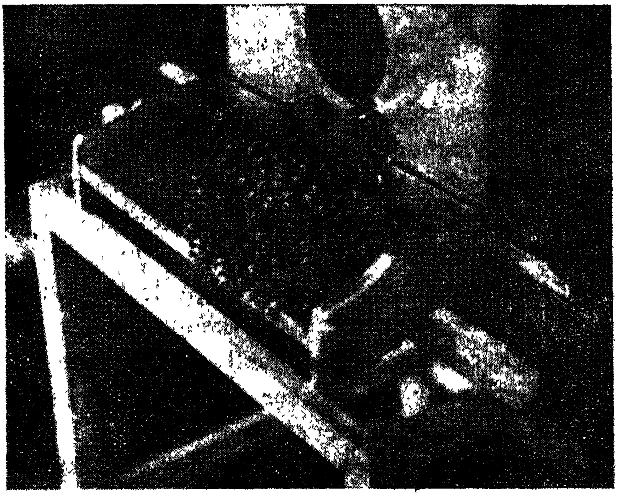


Fig. 17. Bees Fanning In Fresh Air
By Vigorous Flapping Of Tiny Wings.

the cluster and secrete wax upon the wax-pockets underneath the abdomen when the temparature is sufficiently raised. (See 'Production of Wax' in Chapter - 43). They transfer these to mouth for the preparation of the cells of the comb.

The Comb :—Comb is composed of numerous double sided small hexagonal chambers called cells,

arranged in rows with faces in the opposite direction. They branch out horizontally from each side of a thin partition or midrib that separates them. Of the six sides of the cell, two are perpendicular.

Combs are entirely made of wax secreted by the bees, fastened to the support by propolis which is a sticky resinous substance gathered from plants and trees and carried by the bees on their hind legs just as they carry pollen. For secreting one pound of wax in building the combs, bees consume about ten pounds of honey. Bee-keepers want honey and therefore they cannot afford to destroy the comb, for, it amounts to loss of honey which is more than ten times the weight of the comb thus destroyed.

Different kinds of Cells :—There are three different knds of cells where eggs are laid, e. g. (1) the worker-cells, (2) the drone-cells and (3) the queen-cells.

(1) **Worker Cell** :—The small cells of the comb that we see usually are worker cells and are used for rearing workers as also for storing pollen and honey. During the honey flow season both the worker and drone cells are used for the hurried storage of honey, when found empty. Drone cells and queen cells are particularly built during the swarming period. Cells built for the exclusive storage of honey are not quite horizontal, but they slant slightly up and towards the exterior of the comb, both to the right and to the left, from the middle.

(2) **Drone Cell** :—Drone cells are similar to that of the worker cells except that they are slightly bigger in size. They are usually built at the lower part

of the comb, on the sides of the comb and sometimes in the middle. Patches of sealed cells look like a solid mass, and are slightly raised. Drone cells of the Plains type of the Indian Bee and worker cells of the Hill type are of the same size. But the

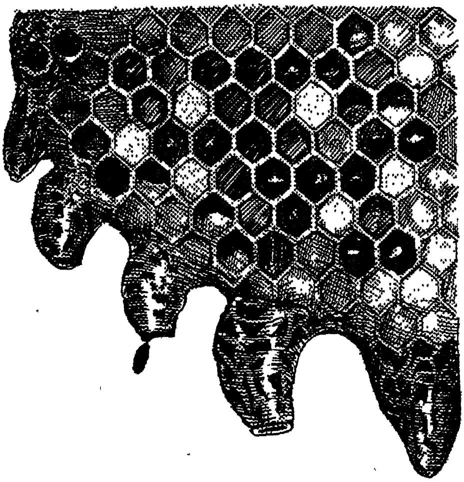


Fig. 18. Queen Cells.
The middle cell showing the hinged Lid.

drone cells of the Hill type are proportionately bigger. (See 'Size of Cells' in Chapter - 30).

(3) **Queen Cell** :—Queen cells are built for rearing queens and are found only during the swarming time or when a colony is queenless or when the workers want to replace the reigning queen. These cells are made of a mixture of wax and pollen and are entirely different from other cells, as can be distinguished by their shape, size and position in

the comb, These are built at the edge of the comb, at the bottom or at the sides and occasionally on the face of the comb. These are round elongated cells, protruding out of the comb with the mouth opening downwards. Swarming propensity of the Indian Bee in the Plains, when not under control, is very great and during the swarming season, 30 to 50 queen cells may be found at any time in an uncontrolled colony. If all the cells are removed once, a good number will be hurriedly built overnight.

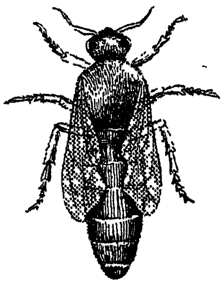
At a stray glance at the wild colony of the Indian Bee, what might seem to be only a cluster of bees round a single comb hanging from a thick line of attachment, will really be found on close examination to be a series of parallel combs hanging side by side with sufficient space between them so that bees may sit with backs against each or pass easily between the combs.

In the natural abode the combs, instead of being drawn out straight and uniform, are very often carved and distorted on account of obstacles inside the hole and ununiform space within. Bees avoid obstacles, resulting in the formation of combs irregular in shape. They join combs together here and there with propolis. In the artificial hive the bees, much to the annoyance of the bee-keeper, fasten the combs together with propolis if the spacing of frames be not correct (see 'Spacing' in Chapter-8), and if the frames do not hang straight down or if the hive be not placed on proper level.

CHAPTER VI

DEVELOPMENT OF EGG

The Queen :—Queen is the mother of all the workers and drones in the hive. She lives for about three years. Bees allow only one queen in the colony to reign over them, and the reigning queen tolerates no other living queen in the hive. She moves about the combs in search of empty cells and lays one egg at a time in a cell. She can lay both fertilised and unfertilised egg at her will. From a fertilised egg, worker will emerge, and from the unfertilised egg will emerge the drone. The same fertilised egg that produces worker, can as well produce a queen according to the supply of food received in the larval state and according to the nature of cell occupied by the egg.



Queen.

The channel, whereby the egg is conveyed from the ovary into the cell at the time of laying, is called the oviduct. There are two such ducts terminating in one, and communicating with it is the Spermatheca which is the receptacle for receiving the seminal fluid from the drone at the time of impregnation. Egg, while passing the entrance to

the spermatheca, gets a very minute portion of the seminal fluid for fertilisation.

Queen Grub :—The egg hatches in three days. White grub can be seen curled at the bottom of the cell, floating in royal-jelly. Grub remains in larval state for about six days and is fed with royal-jelly all along. The cell is then capped. Inside the cell, grub transforms into pupa, and in about six days more, the fully developed queen emerges out of the cell by cutting open the cap. She forces her way out by pushing her head against the cap while there still remains a small portion to be cut off. The round cap then hangs like a hinged lid (Fig. 18), and sometimes remain in position—the cap behaving like a spring. Bees that surround the outer side of the queen cell, also help in thinning out the cap. The empty cell is then demolished by the bees. The colour of the ripe queen cell is deep brown. (See 'Ripe Queen Cells' and 'Emerging of Queen' in Chapter-24. For the description of 'Queen Cell' see Chapter-5, page 45).

The young queen after emerging out of the cell will be in search of rivals, and if allowed by the workers, will kill the undeveloped queen grubs in their cells. In about a week, the queen goes out of the hive in the open air on a nuptial flight if the weather is fair. Queen may be expected to come out of the hive and take wing at any time beginning from midday upto the time of sunset if there is enough bright light then and the day is warm. But generally she comes out in the afternoon. In the bee atmosphere

there are drones flying about. Queen may mate with a drone of a neighbouring colony or with one of her own hive. The queen goes out silently, followed by the drones. Sometimes a lot of workers also follow the queen.

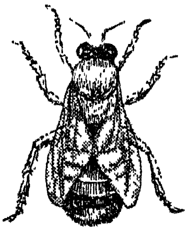
In the air the virgin queen mates with a drone and being impregnated comes back to the hive carrying a part of the male organ, a sting-like whitish substance, sometimes very faint orange-yellow in colour, which is taken out carefully by the workers attending her on her return. Generally the virgin queen mates with a drone once in life (see Chapter - 33), and goes on laying fertilised egg till the seminal fluid received from the drone is exhausted. If the queen be unsuccessful in mating on the first day, she will go out on subsequent days and in about a week will be fertilised, and if not, she may take a long time. (For 'Queen Rearing' see Chapter - 24).

The author has seen the Hill type of queens, while in the Plains, taking a good lot of time when not fertilised within a week or ten days. He has observed black queens taking 21, 27 and even 32 days in mating. But the mating of the Plains type of queens (brown queens) is quite an usual affair and it takes place at all times of the year provided there are drones.

If the queen fails to mate, she remains a virgin. So far as the Plains type of queens are concerned the author has never seen a single queen remaining virgin, but that is not his experience with the Hill type of queens. Unfertilised queens and old queens give birth to drones only.

The Hill type of queens, in the plains, as has been observed by the author, have a peculiar habit of very often missing their own hives while returning from nuptial flights. They often alight on wrong hives, even when hives are placed 25 feet apart, and the disastrous result is that the queen, on alighting, is attacked by the workers on guard, 'balled' and killed, (see 'Balling the Queen' in Chapter-22), and if she succeeds in entering the hive remaining uninjured, will kill the reigning queen.

The Drone :—The drone eggs hatch in three days. Grubs are fed with royal-jelly for about three days, and for three days more, with *bee-bread* which is a mixture of pollen and honey. Cells are then capped and the grubs pupate. By about the 25th day from the laying of eggs, drones come out by cutting open the caps. They remain inside the hive for most of the day. After about two weeks, drones leave the hive for flight and search virgin queens. They fly about with vigorous booing in the afternoon and visit hives, as may be seen hovering near the entrance. They pay special attention to hives that are queenless or have virgin queens or queen cells. They make their way into the hive without minding the bees that may be at the entrance. Sometimes they push their way in. Bees do not, rather, cannot resist them. Bees guarding the entrance will resist a worker of another hive if by mistake she happens



Drone.

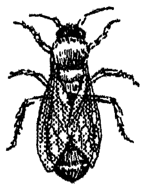
to come to the wrong one. But the drones have free access to every hive.

Drone's function, as has already been said, is to impregnate the virgin queen. Intercourse takes place in the air while on wing. In fulfilling this mission of life, the drone dies by the rupture of the male organs. Then again, they are not wanted when the swarming season is over, for, it is during this period that the services of drones are specially required. They are deliberately driven out of the hive by the workers. Drones live usually for about four months. Size of the drone becomes small if drone egg is laid by mistake in a worker cell.

That the drone, the male member of the bee colony, lives on the labour of the workers, is a fact. It cannot but be otherwise. And it so happens that in human society, idle fellows are compared with drones. But can we bee-keepers, as lovers of bees, call drones as idle insects? Idle is one who being capable of work would shirk it. Does this apply to drones? The tongue of the drone is short and therefore it cannot suck nectar from flowers. It has not the honey-sack for necter to be filled in and brought to the colony. It has no wax-plates for the secretion of wax. It has not the sting even. The body of the drone is heavy and strongly built to meet one special purpose and that is to fertilise the virgin queen. The drone at the cost of its life serves the colony, for, we know that without a fertilised queen a bee colony is doomed. Thus it is a life of sacrifice that the

drones live and we may not thoughtlessly call drones as idlers.

The Worker :—The egg hatches in three days. Grub is fed with royal-jelly for three days, and for three days more, with bee-bread. The cell is then sealed with a porous cap made of wax and pollen. The larva pupates and comes out after cutting the cap, as a full fledged bee in about 21 days after the laying of egg. The empty cell is then cleaned by the workers and made ready for receiving the next egg.



Worker.

A day after her emerging out, the worker begins the duty as a nurse, and after about two weeks she works as a forager. (See 'Functions of Young Bees', under 'Snelgrove's Method' of Swarm Control in Chapter-25). Eggs laid in the old cells will produce dwarf workers on account of the size of the cell having been reduced by portions of cocoons left in the cells by ceaseless breeding.

Workers live for about three months and a half generally. During the honey flow season their span of life is about one month and a half. They die early on account of exhaustion due to overwork during the season.

Workers cannot be impregnated. But it is found that in a queenless colony when there are no eggs or young larvae to raise queens, or for some reason when the rearing of queen is delayed, some workers take upon themselves the duty of the queen mother and begin to lay eggs. These *laying workers* lay

several eggs in a single cell. All the empty cells would thus be laid and all the combs would be fouled. Workers' eggs being not fertilised, nothing but drones could be hatched out of these eggs. In their attempt to requeen the colony, the laying workers would even lay eggs in the queen cells built by other workers of the colony. When several eggs are thus

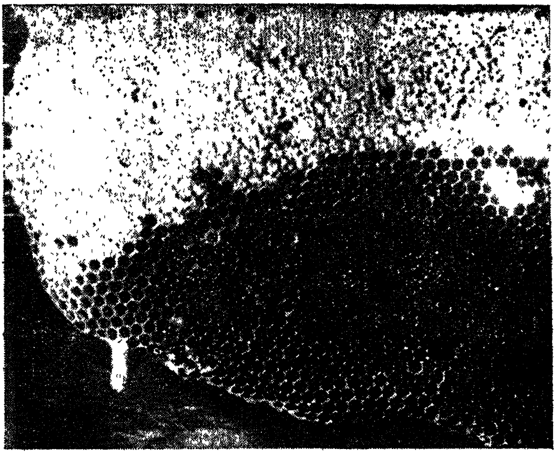


Fig. 19. A Giant 'Queen'-Cell
Containing Drone Pupa.

laid in a single queen cell, the nurse bees keep only one egg in the cell and remove the rest. They lavishly feed the drone larva in the queen cell, and the pupa dies.

These queen cells are drawn abnormally long and when capped they look monstrous. (See 'Laying Worker and Queen Cell', Chapter - 34). Presence of

virgin queen generally stops the egg laying of the laying workers. Sometimes they continue this dirty job till the virgin queen is impregnated and starts laying.

Capping of Cells :—The worker pupa is capped with a flat capping and drone pupa with convex capping. The centre of the drone cap is brown and has a minute hole in the middle. Caps of the drone cells are generally found on the bottom board of the hive when drones emerge out of the cells. Workers are very reluctant to throw these caps out of the hive. A few drone caps are sometimes found on the alighting board being carried away by the movement of the workers due to constant passing through the entrance. Cells containing honey are also capped. Cappings of honey cells have got a shinning appearance, whereas the brood caps look dull.

Food of the Bee : Honey and Pollen :—*Honey* is the food of all the adult bees. Grubs are fed with *Pollen* mixed with honey. Pollen grains are gathered from the stamens of flowers by the bees in the two pollen-baskets on their two hind legs (Fig. 10). Stamen is the male organ of flower which produces pollen. Being attracted by gaudy colour, sweet odour and nectar, bees visit flowers and thereby help pollination as has already been said. Bees may be seen quickly moving to and fro on the flowers and collecting pollen. They sometimes seem to roll on the flowers. They smear the body with pollen, move away and fly near the flower for a few seconds, and while in the air, transfer the pollen grains from

the body with the help of the other legs, to the pollen baskets. And as soon as that is finished they fly back to flower and begin anew the process. The pollen on the two hind legs look like two balls when sufficiently collected.

Returning to the hive they scrape out the pollen and store it in the cells. Cells are thus packed solidly with pollen. Cells containing pollen are covered at the top with small quantities of honey and sealed with wax. This is done in order to stop deterioration of pollen by coming in contact with air. Cells partly filled with pollen also contain honey full upto the top and sealed. (Also see 'Pollen and Pollen Substitute' in Chapter - 12).

Pollen is moist when it is brought to the hive and it gives a slightly sticky feel when pressed between the fingers. Pollen stored for a long time and not covered with honey and sealed, dries up in the cell. It cracks and crumbles when pressed. Sometimes fungus grows on the pollen on standing, if cells are kept open, and its colour also changes.

Pollen is stored in the side-combs, particularly on that side of the hive by which the bees get in through the entrance. Colour of pollen varies according to the variety of the flowers from which it is gathered. These colours are,—white, dull yellow, primrose yellow, orange yellow, brown, scarlet, ash and black.

Necessity of Pollen :—For the growth of human beings, animals and insects, protein is absolutely necessary. We get our protein from milk, cereals and

pulses. As a food for the bees pollen is important because it supplies the necessary protein. It is not so important for the adult bees as for the young ones and for the growth and development of the brood.

Distinctive Feature of Worker and Drone :—Male and female bees can be distinguished by their eyes. The two compound eyes of the drone very nearly meet over the head, (Fig. 8, page 26), while those of the worker are far apart (Fig. 9, page 27). This feature can also be noticed in the pupa stage. Viewed from the front the head of the drone looks very nearly round, while that of the worker looks triangular. Drones are slightly bigger in size than the workers. Drones are also darker in colour.

Colony Odour :—Every colony has its own individual odour and the bees recognise each other by this distinctive smell of the colony. This odour is commonly known as the 'Hive Odour'. Young bees and drones are allowed to enter into hives other than their own, whereas adult workers are regarded as robbers and treated as such. They are grabbed and done to death. Bees lose their smell when they are separated from the colony for some time. Thus separated, they are treated like strangers and enemies when they come back or are brought back again to the colony.

Apart from the colony odour, every queen has got her own odour also, and thus a strange queen entering into a hive is recognised immediately.

CHAPTER VII

ENEMIES AND DISEASES OF BEES

Enemies of Bees :—Bees have their natural enemies. There are *wasps* and *hornets* that hover near the hive and carry the bees off from the alighting board and also when they are on play flight. (See 'Play Flight' in Chapter - 22). Then, there are *ants* that crawl up the legs of the hive-stand. Black and brown ants attack the combs for grubs, bees and honey. Being disturbed by ants and being unable to protect themselves, bees desert the hive.

There are *lizards* and *spiders* that eat bees. There are *toads* that take shelter near the hive. They devour adult bees that happen to fall on the ground, and young bees that fall near the hive during the play flight. Ants also take their toll when bees are found on the ground. There are very small black *beetles* that infest the hive, and there are the *cockcroaches*. Both are troublesome. They nibble the exposed combs here and there, but they are not much harmful. Then there are the *bee-lice*, the *wax-moths*, the *birds* and some hovering insects other than the hornets and wasps. Names of a few other enemies may also be mentioned.

(1) **Bee Louse** :—The bee-louse *(Braula Cæca)* is a wingless tiny insect of reddish brown colour. In

appearance it very nearly resembles a flat miniature crab. They are sometimes found attached to the bodies of the workers and the queens.

The author has found from time to time, wild swarms to have been affected, with a particular class of louse of the same colour. These take shelter on the grooves of hives on which the shoulders of frames rest, when swarms are hived. The colour of the young insect is lighter in shade. The size of the full grown louse has been found to be slightly less than one-eighth of an inch in length and less than that in width. They have four pairs of legs and apart from that, a pair of large claws. The claws are similar in appearance to those of a crab or a lobster, and have also the pincers. The head is small and the abdomen large and flat.

Mr. Tickner Edwardes in his 'Bee-keeping For All' writes thus about *Braula Cœca*,— "It is a small, round creature with six fringed legs, and is of a bright brown colour". Mr. Herbert Mace writes in his 'Modern Bee-keeping',— "It is about one-eighteenth of an inch in length, reddish brown in colour, and resembles in general appearance a minute spider." Then again, in Root's 'ABC and XYZ of Bee Culture' we find the following about this insect,—"In 1818 the species was named *Braula Coeca* by Nitzsch. It was said to belong to the Pupipara, which is a group of diptera, or two-winged flies. All of these flies are parasitic, and some are wingless." So, it seems that there are several varieties of this insect.

Changing the hive from time to time is the easiest way to get rid of them. It has been suggested

that the adult *Braula* may be dislodged from the bodies of the bees "by means of a puff of tobacco smoke". The insect does not injure the bee, but gets nourishment by taking food from the mouth of the bee, thus compelling it to feed.

(2) **Wax Moth** :—Moth belongs to a family of insects like butterflies. But one must not mistake a butterfly for a moth. They can be easily distinguished. Distinctions are simple. Butterflies are active during the day, while the moths fly about mostly at night. Butterflies, when at rest, sit with their wings straight up, vertical. But the moths sit with their wings folded over the abdomen or spread out horizontally. Wings of both the butterfly and the moth may either be plain or bear designs, with or without various colours.

Silk producing worms are typical moths of big size with beautiful designs on the wings. Moths of the type of Mulberry and Eri (Endi) silk worms have been domesticated in order to get 'cocoons' for our own purpose which is to spin yarn to be woven into fabrics. At the time of passing into pupa, the larva by drawing a thread from the mouth, spins a silken cover or sheath in which it encages itself and pupates. This silken case or sheath is called cocoon. In the cocoon, the pupa or Chrysalis undergoes transformation and then emerges out as a perfect winged insect.

We have found the Eri silk worms quite harmless to bees and combs. As enemies of bees, bee-keepers are not concerned with moths like these or butterflies,

however small the size of the latter might be. But they are to guard against the depradations of a particular type of moth called the 'Wax Moth' or the 'Bee Moth'. In some places they are called *Diwali Poka* (*Fatinga*).

There are varieties of moths that trouble the bees. Bees can successfully fight the 'Death's-head Moth', but the small wax moth is the worst enemy. Death's-head Moth is a species of large moth so named on account of a pale marking on the thorax resembling somewhat a human skull. These moths are harmless. They come at night and enter the hive to steal honey. Dead moths of this variety are sometimes found in wild colonies and sometimes in frame-hives also. They can hardly escape the attacks of the bees. These moths are generally found during the rainy season.

In our Sodepur apiary we have seen some of these, blackish in colour and fairly big in size, measuring about 2½ inches in length and 1½ inches in width. In one instance, in one of Pratisthan's apiaries in the mofussil, there were determined attacks of these moths for some days together in the evening. They flapped their wings, hovered round the hives, and tried to enter. We had to resist and destroy over one hundred of these by striking, after which there were no further attacks.

The wax moths that prey upon the hives are small in size and are of two species, e. g. the 'Greater Wax Moth' (*Galleria mellonella, Linn.*) and the 'Lesser Wax Moth' (*Achroia grisella, Fabr.*). One is

larger than the other. Of these, the caterpillars of the former are most destructive. All the 'Greater' wax moths are not of the same size as will be evident from the photo printed here (Fig. 20). Their cocoons and pupæ (Fig. 21) also differ in size.

The Greater Wax Moths are of two kinds. The wings of one are greyish and the thorax deep brown, while the wings of the other are light cream and the thorax reddish brown. The wings of the Lesser Wax Moth are of light cream colour only, and the thorax reddish brown.

Fig. 20 (upper row).
(i) THE 'GREATER' WAX MOTH (the left three show their different sizes).
(ii) THE 'LESSER' WAX MOTH (the smallest one to the right).

Fig. 20 (lower row).
(i) 'Caterpillar' of Greater Wax Moth, (left).
(ii) 'Caterpillar' of Lesser Wax Moth, (right).

Their eggs hatch, caterpillars pupate and wax moths come out of the cocoons. Cocoons are of dull white colour and found usually covered with black pellets of excreta. But that depends on their position in the hive where they pupate, for, cocoons are sometimes found without those black pellets. Caterpillars pupate in the corners of the hive here and there, as also inside the eaten combs and on the bars of frames.

Wax moth enters the hive at night and lays eggs on the small particles of wax or other refuse matters that may happen to be on the bottom board, and when convenient, also lays eggs on the combs. It comes during the day also and lays eggs in the crevices. Any crevice with a possible communication inside the hive is quite good for their egg laying. Eggs are so small and laid so close to each other that in the naked eye they look like a small patch having a dull white colour Eggs make a cracking sound when pressed with the blade of a knife.

Fig. 21 (upper row).
(i) Three different sizes of 'Cocoons' of Greater Wax Moth, covered with black Pellets, (left).
(ii) Cocoon of Lesser Wax Moth covered with black Pellets, (smallest one to the right).

Fig. 21 (lower row).
(i) Three Pupæ of Greater Wax Moth, taken out of the cocoons above, (left).
(ii) Pupa of Lesser Wax Moth, taken out of the cocoon above, (right).

Caterpillars just hatched, when disturbed, leap out and scatter themselves. They creep up, get on to the comb and eat away wax making tunnels inside, though bees may be sitting on the comb. They cover the empty cells with silky webs and fill the comb and the bottom board of the hive with black pellets of

excreta. When the whole comb is thus affected, the bees recede to the next comb. Sometimes two or more combs are joined together so fast by the silky nets that it becomes difficult to separate them.

It is not easy to detect the attack in the earlier stages. Caterpillars can be seen moving in the tunnels if the comb is held against the sun, after the bees are

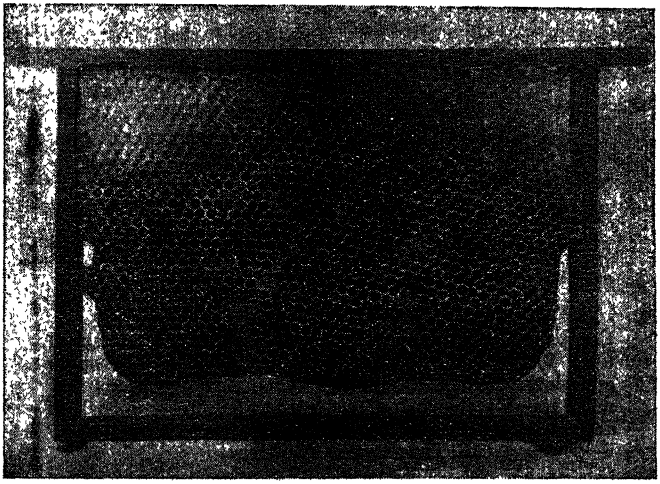


Fig. 22. An Infested Comb,
Showing the Tunnels and Silky Webs.

being removed by shaking them off. (See 'Removing Bees' in Chapter - 13). Owing to the heat of the sun, caterpillars come out and seek shelter on the other side of the comb. These can then be easily removed with the aid of forceps and thrown away. Best way to avoid them is to keep the colony strong so

that combs may be covered fully by the bees, and to examine the hive from time to time and change it to keep the bottom board clean. (See 'Honey Bees and Rainy Season', Chapter - 36).

Fig. 23. Ravages of Wax Moth Caterpillars.
Combs rendered useless by caterpillars which measured upto 7/8″ × 1/8″. The two white patches are spots completely eaten away, the space having been filled with tough web-work of caterpillars. The small white dots and dots in lines are cells covered with silken nets. Tunnels are also there.

(3) **Birds** :—There are certain insect-eating birds. The green bird called 'Bee-eater' (known in Bengal as *Narun-chora*) and the black bird 'King-crow' with forked tail (known in Bengal as *Finga*) catch the bees while they are on their wings and eat them.

Bee-eaters are commonly seen on telegraph wires, wagging their tails up and down and making a sharp sound like '*tui, tui, tui*'. These birds create havoc during the honey flow season when the bees

are very active and the apiary resounds with the humming. They make their presence feel in the bee yard first in October, and then they appear again in February.

(4) **Hovering Insects** :—Apart from the wasps and hornets among the insect-enemies of bees already mentioned, there are the *Dragon Flies.* They are confirmed enemies of bees, and are equally teasing and destructive as the hornets are. They are persistent attackers. They hover near the hive and in the open yard, and swoop upon the prey while it is on wing. We have seen three varieties of dragon-flies. The size of one is very big and the smallest one is a tiny insect of a very light weight.

Fig. 24. The Dragon Fly.

These insects belong to the order which is called Neuroptera, They lay eggs in water, particularly in ponds and pools. Eggs hatch out into larvae

and live in water till they are ready for land life. They have a freely movable large head, strong jaws, big compound eyes, two pairs of long narrow net-veined wings, three pairs of legs, long and slender abdomen. Legs are adapted for grasping the prey.

(5) **Other Enemies** :—It is well to bear in mind the pranks of the black-faced monkeys (*Langur*). Out of curiosity they sometimes throw the hives off from their stands to no good to themselves. For they are to run away for their lives after having tasted a few stings. But the mischief is already done then.

The jackals are known to be cunning, and during the honey flow season the smell of honey near the ventilators of the hive also become very tempting. What happens at night is not known, but the bee-keeper must not be surprised if one fine morning he finds a hive thrown on the ground and the combs lying scattered all over. These difficulties are rare and can be avoided by tying the hive and the stand together with a piece of cord.

And lastly, the bee-keeper by unnecessary handling of bees, risks the normal growth of the colony which must also be avoided. (See 'Unnecessary Handling' in Chapter - 13).

Diseases of Bees in India :—The Indian Bee (*Apis indica*) is healthy and free from diseases. No ailment has so far been noticed in Apis Indica subjected to modern methods of bee-keeping, and none has been reported. It remains to be seen how they withstand the general run of domestication that is ahead of them. We have every hope that Apis Indica

will not be affected in any way unless they get the infection through European bees imported from countries outside India. Disease or no disease, it is most important that a bee-keeper should keep a vigilant eye over his bees while handling the combs and manipulating the stocks, and note carefully every uneasy movement and abnormality found, so that these may be traced and steps taken.

Bee Diseases in European Countries :—It may be mentioned that the European bee (*Apis mellifica*) is subjected to various infectious diseases affecting (i) the brood, and (ii) the adult bees, with disastrous results. These diseases do not concern the Indian bee-keepers in any way, and we may not like to implant these maladies in India by importing foreign bees. (See 'European Bee and Diseases', in Chapter - 17). We would like to remain content by acquainting ourselves with their names and a brief description here.

(I) DISEASES OF BROOD :—The wide-spread and destructive brood disease is called 'Foul Brood' of which there are two classes, e. g. 'American Foul Brood', and 'European Foul Brood. (1) In *American Foul Brood,* the sealed brood is usually affected. Appearance of the sealed brood becomes irregular, cappings are torn by the bees, bad smell emanates from the decaying larvæ. The safest treatment is to burn all combs and bees of the infected colony. (2) *European Foul Brood* is also a highly infectious disease. Usually the young larvæ are affected soon after hatching. When expert assistance cannot be

obtained, the best treatment suggested is to destroy the affected colonies and thus stop its spread.

It is said that next to American Foul Brood is, (3) the *Addled Brood* disease that is most prevalent. Larvae die both before and after being sealed. The disease is not infectious, and the treatment suggested is the replacement of the reigning queen by a new one. In another disease called (4) *Chalk Brood* which is to some extent infectious, only the sealed larvae are affected. Pupae become white and brittle. Suggested remedy is the removal of the affected combs. Then there are two more diseases of brood known as (5) *Sac Brood,* and (6) *Stone Brood.*

(II) DISEASES OF ADULT BEES :—Of the diseases of adult bees, the name of *Isle of Wight Disease* may be mentioned. It made its appearance first in the Isle of Wight in 1904. The prevalence of the malady in Great Britain for a long time and its serious devastation stimulated research work, with the result that the existence of several different diseases were recognised exhibiting many symptoms in common. Diseases associated with the presence of specific organisms in bees are, (1) Acarine disease, (2) Nosema disease and (3) Amœba disease.

(1) *Acarine disease* is due to attack of the breathing tubes of the bees by a particular parasite. At an earlier stage, bees become weak, life is shortened and the efficiency of the colony is reduced. At the last stage, bees lose the power of flying and have distended abdomen. From the alighting board they fall on the ground and begin to crawl. Sometimes,

mass crawling occurs and thousands of bees may be found to be crawling on the ground near the affected hive. Sometimes they crawl up the stems of grass and other weeds and gather in small clusters. Of the treatment, one known as the 'Frow Treatment' discovered by Mr. R. W. Frow, lies in administering the vapour of a mixture made of Nitrobenzene, Petrol and Safrol Oil. It should be noted that the mixture is highly inflammable and poisonous. Then, there is the Sulphur Treatment for Acarine disease which lies in the application of fumes of Sulphur, with the aid of a Smoker, mixed with other ingredients. Another treatment is fumigation with Oil of Wintergreen (Methyl Salicylate).

(2) In *Nosema disease* the lining of the bee's stomach is attacked and destroyed by a microscopic parasite. It is infectious. In an advanced stage, affected bees cannot fly, they fall on the ground and lie upon their backs with legs trembling. Cleanliness of hives and the surroundings of the apiary are suggested. Dead bees and old combs should be burnt and the ground round the hive disinfected.

(3) In *Amoeba disease* the excretory tubes of the bee are affected by a certain parasite.

Dysentery :—In dysentery, bees discharge their excrement on the walls of the hive inside, on the bottom board and on the combs, as also on the alighting board or all over the hive. The evacuations vary in colour from dirty yellow and brown to darker shades, and have an offensive odour. Dysentery is caused by long confinement of the bees when they

cannot come out to ease themselves, and by the consumption of unsuitable food—fermented honey, or syrup made of bad sugar. (See 'Preparation of Syrup' in Chapter-12). It is also caused by excitement on account of some disturbance, as also consumption of food in excess of their needs during a period of inactivity.

Bees usually void their fæces while on wing, and the hive remains clean. But due to abnormal conditions as stated above, they fail to retain their fæces and control themselves. Unless accompanied by the symptoms of other diseases, dysentery by itself, therefore, need not be considered as a disease but a condition arising out of the reasons already given. Treatment lies in changing the hive, removing the soiled combs, giving sealed honey, looking after proper ventilation, and leaving the bees undisturbed for some time.

CHAPTER VIII

HIVES AND APPLIANCES

Before one directly proceeds to get bees, certain appliances have got to be arranged. These are,— (1) Hive for the bees, complete with Frames and Dummy-board ; (2) a Bee-veil and (3) a pair of Gloves for the protection of the face and hands from the sting ; (4) a Smoker ; (5) Feeding-bottle ; (6) a Penknife and (7) a Scraper Knife ; (8) a Hive-tool and (9) a pair of Scissors ; (10) a Screw-driver, (11) a small Hand-drill and (12) a pair of Pliers ; (13) a strong Feather ; (14) Frame-stand ; (15) Hive-stand ; (16) three Swarm-catching Nets ; (17) a few Earthen Plates ; these plates are to be fillled with water and placed under the legs of the hive-stand. This is to prevent the ants from approaching the hive ; (18) a Honey Extractor ; (19) a pair of Uncapping Knives for cutting out the sealed caps of honey combs, necessary at the time of the extraction of honey ; (20) an Uncapping Tray ; (21) Queen-excluder ; this is for preventing the queen from approaching certain parts of the hive where and when her presence is not wanted. A full description of the above appliances and their uses are noted below.

Beginners may first of all get those appliances that are immediately required to start the work with. Other appliances may be procured as convenient.

The hive and the extractor cost a little more in comparison with the cost of the other items.

Advantages of Artificial Hive:— By modern bee-keeping is meant the skilful and intelligent management of bees, housed comfortably in artificial hives for the increased production of honey, without

Fig. 25. Inspecting A Comb.

killing the bees and grubs and destroying the combs. This has been made possible by the adoption of removable frames for comb-building, having the hive opening at the top. The removable frame-hive was invented in 1851 by the Rev. L. L. Langstroth of America, then a Presbyterian minister. This invention

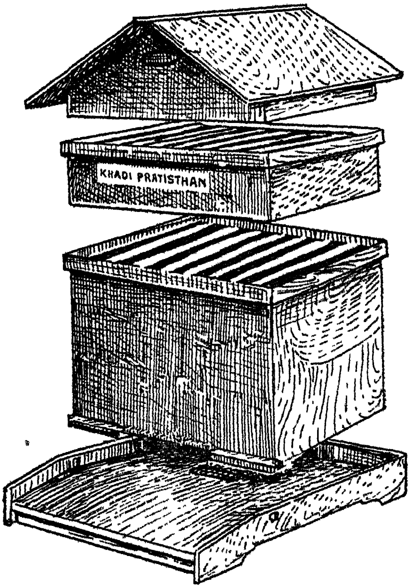
is a landmark in modern scientific bee-keeping. It has opened out the mysteries of the bee colony. It has made possible for the bee-keeper to handle and inspect the combs with bees adhering, to examine the grubs and eggs in the cells, and to see the queen moving about. The bee-keeper can transfer the combs from one hive to another, divide the colonies artificially, and control the natural swarming of bees. He can graft queen cells from one comb of a colony to another, rear and introduce queens and manage the bees in any way he considers suitable.

(1) **The Hive : Brood Chamber and Super** :— The beehive usually consists of four parts, as illustrated here, viz.—(1) the Bottom Board or the Floor Board, (2) the Brood Chamber or the Body Box, (3) the Shallow Chamber or the Super Box, and (4) the Roof.

The two boxes called 'chambers', tops and bottoms of which are open, are for holding the Frames. These chambers are placed one upon the other. A third chamber may be added when a colony is exceptionally strong. The lower chamber is called the body-box or brood-chamber, and the upper one is called the super-box or shallow-chamber. The frames of the brood chamber are called brood-frames or deep-frames, while those of the upper chamber are called super-frames or shallow-frames. The lower chamber is for brood rearing and the upper chamber for the exclusive storage of surplus honey. The front of the lower chamber has a small opening at the lower end for the entrance and exit of the bees. There are two door-slides with the aid of which the aperture of the

entrance can be adjusted or closed entirely. The internal measurements of the two chambers depend on the size and the number of frames intended to be accomodated in the hive.

There are two grooves about $\frac{3}{8}$ inch deep—according as the top-bar of the frame is thick—on the upper edges of the front and back planks of both the chambers, to hold the frames. Shoulders of frames are placed on these grooves flush with the tops of the chambers, and the frames hang down straight. In the wild colonies of Apis Indica in the Plains, it is found that bees build combs straight from front to back, and go on building fresh combs on the right and on the left. In other words, they build combs at right angles to the entrance i.e. the front. In artificial hives, the frames are kept suspended in that order, following the natural inclination of the bee. Some bee-keepers arrange the frames parallel



Hive Showing The Different Parts.
Floor-board, Body-box,
Super and Roof.

to the entrance. The frames, when in position, are in level with the upper edges of the chambers.

The Bottom Board :—The lower chamber rests on a piece of plank called the bottom-board or floor-board, the front portion of which is used by the bees for alighting and for flying out, and is called the 'alighting-board' or 'flight-board'. The alighting board has a slope towards the front. Bees have a tendency to creep up, and this slope downwards helps the bees, on alighting, to walk straight towards the entrance of the hive.

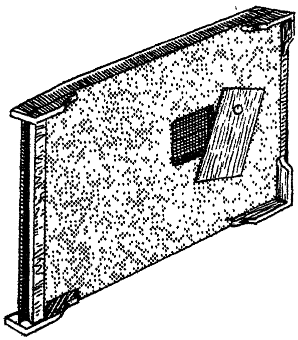


Fig. 26.
Underside of Floor-board
Showing the Ventilator.

In the centre of the bottom-board there is a round hole 2 inches in diameter, or a square hole with rounded corners, covered on the upper side with a piece of wire gauze having about 16 lines to an inch. It serves as a ventilator and can be opened or closed with a piece of wood, screwed down on the other side of the bottom board with a single screw.

The Roof :—A removable 'Λ' shaped roof, covers the upper chamber. In the gables i. e. the triangular parts between the slopes of the roof, both in the front and at the back, there are two holes $2'' \times 1''$ which are covered from the inside with wire gauze. These serve as top ventilators. The roof may also be flat instead of

being 'Λ' shaped. In that case the roof will have a slope from front to back for draining off rain water that may happen to fall on it. Flat roofs can be conveniently used for keeping the appliances while manipulating the neighbouring hives.

Types of Hives and Sizes of Frames :—There are various types of hives which differ both in external

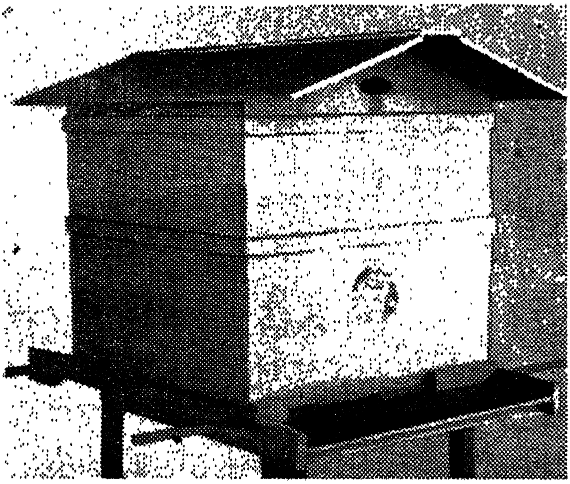


Fig. 27. Standard-frame Hive: Sodepur Model.
Brood-chamber to accomodate
12 British Standard Frames.

design and in structural detail. Some of the hives are single-walled and some double-walled. The sizes of frames are also more than one. The question arises as to which hive is to be selected. The first thing that comes into consideration is the size of the frames, and the number of frames the hive is to

take. And it should be noted that the dimensions of the frame and the number to be accomodated ultimately determine the size of the hive.

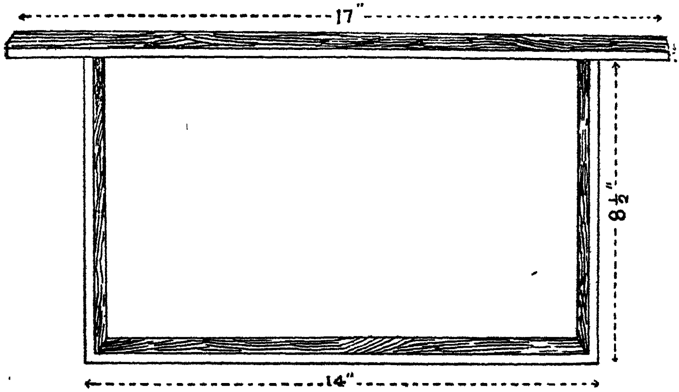


Fig. 28. British 'Standard' Brood-frame.

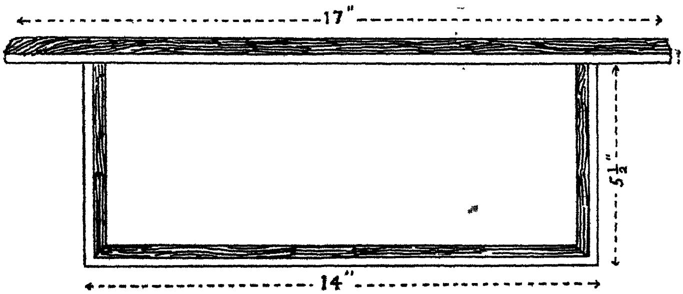


Fig. 29. British 'Standard' Shallow-frame.

In England the British Standard Frame is popular. The word 'standard' indicates a particular size of the frame adopted. In America the Langstroth Frame

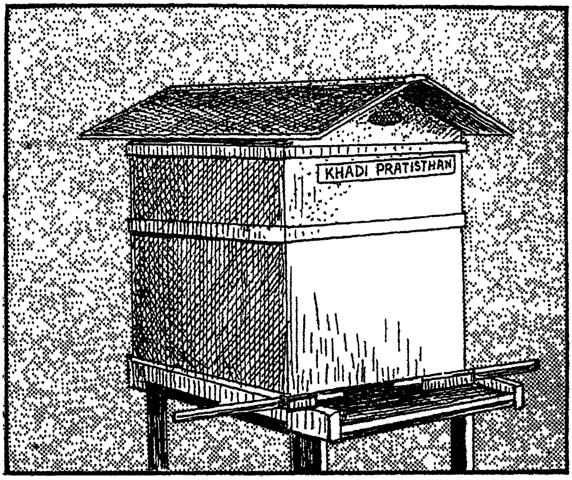
is popular. The 'Modified Dadant' frame is also in use. The last two frames are bigger than the British Standard frame. In India the British Standard frame and the Langstroth frame are both in use. And a third frame known as the Newton frame which is the smallest of all in size, is also in use. (See 'The Newton Hive' below).

Hives are known by the name of the frame used, e. g. the British Standard Hive, the Langstroth Hive. They are known by make also, e. g. the "National" Single-walled Hive, which is the hive of a type first introduced by Messrs. Burtt & Son, Gloucester, now being given a standard pattern under the auspices of the Ministry of Agriculture in London, named as such and officially recognised; the double-walled "W. B. C. Hive" originally designed and introduced by the late Mr. W. B. Carr which contains ten British standard frames in the brood-chamber and the same number of frames in the Super. There are hives of other makes also.

It may be noted that in India the single-walled hive is quite good except in places where the cold is severe and bees require special protection from chill. The double wall of the hive helps to conserve the heat within, the air-space between the walls is either kept empty or packed with chaff or some other material to make it a better non-conductor. (See 'Wintering' in Chapter - 9)

The 'Newton' Hive : Different Hives in use in India :—In 1911 the Rev. L. V. Newton of the St. Joseph's College, Trichinopoly, (Madras, India),

successfully domesticated the Indian Bee and got surplus honey. He introduced smaller frames, nearly half the size of the British Standard brood frames. Frames half the size of standard brood frames clipped on to full-sized top bars are used in England for queen rearing. These small frames, fitted with comb foundation, are given to a strong colony. When



Newton Hive : Sodepur Model.

combs are built and the cells are filled with the brood, these small combs are removed and accomodated in a small hive called the queen-mating hive. The Rev. Newton adopted frames similar to these frames, and his small-sized frames being first worked and introduced by him in India are known as the 'Newton' frames. The Rev. L. L. Langstroth is the father

of modern bee-keeping in America. With a deep sense of gratitude it must be acknowledged that the Rev. L. V. Newton made modern bee-keeping practicable in India.

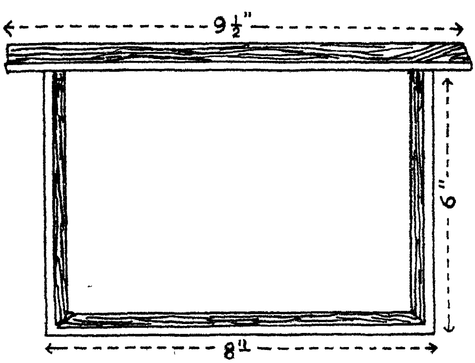
In South India the Newton frame is in use, and it has proved its worth. Travancore leads India to-day in bee-keeping where honey is being produced in commercial quantities under modern methods. The Newton frame is in use here. In the Plains where pasturage is abundant, the British Standard frames are giving satisfactory yield. But speaking generally, the Newton frames are well adapted for the Plains, because one is sure to get surplus honey, whereas, the bigger frames though they facilitate increase in population on account of their size, generally leave a negligible quantity of honey for the bee-keeper, except in the locality, as has been stated, where there is exceptionally good pasturage. For, most of the honey is being used up in feeding the larger number of grubs and young bees and in making their own provision for the slack season.

In the hilly tracts of Northern India, bee-keepers use the Langstroth frame. They have their advantages in the hills to adopt that size. These advantages are not available in the Plains; but that cannot preclude the people inhabiting the Plains from practising this most interesting industry. For them the Newton frame is the standard.

There is no one uniform size of the Newton frame. Frames are made according to the individual likes and dislikes of the apiarists. Therefore, sizes differ

though the variations are slight. One fixed standard size is a necessity. At the Sodepur Apiary, both the Newton and the British Standard frames are in use. The two sizes of the Newton frames, the deep and the shallow, that are in use at Sodepur are given here (Figs. 30 & 31).

Fig. 30. Newton Brood-frame, (Sodepur Size).



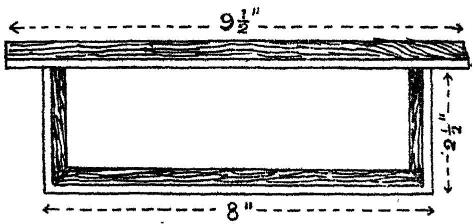


Fig. 31. Newton Shallow-frame, (Sodepur Size).

The size of the hive also varies on account of the difference in the size of the frame. For a Newton hive holding 7 frames, brood chambers of different sizes are used. They differ in width also. Sometimes frames are accommodated so close to each other that they are pressed at the two side-walls of the hive leaving no finger-space for manipulation. And the result is that the bees boil up when the bee-keeper attempts to raise the first comb.

The alighting board is sometimes abnormally short. Bees scorched in the April heat during the day, come out of the hive at night and in the absence of sufficient space on the alighting board, having spread themselves over the whole front of both the chambers, cluster underneath the bottom board. They enter the hive at the first glimpse of dawn and the foragers begin their daily toil. It seems that the hives are so made only to curtail the cost. This economy puts both the bees and the bee-keeper to difficulty.

Whatever the size of the frame may be, it is of the utmost importance that it must be of one uniform measurement, for occasions arise when interchange of frames becomes necessary. So far as the Newton frames are concerned one must select a size and stick to it, and see that the same is being used by the neighbouring bee-keepers in order to avoid difference in size in the same area. A beginner would do well to adopt a size that is already in use in the locality. (See 'The Standard Newton Frame', Chapter - 39).

In a suitable area, the yield of honey from bigger hives is greater than that received from the smaller ones subject to the conditions already stated. (See 'Honey Yield', Chapter - 17). For a beginner, in the Plains, a pair of small hives to start with would be advisable. Having gained experience and being confident of handling and controlling more bees, and after taking into account the possibilities of the locality, one may change over to bigger hives. The small hives then, if desired, may either continue to

be used as such and yield honey or may be used as Queen Mating Hives.

Spacing of Frames :—There are four bars in a frame,—the top-bar, the bottom-bar and the two side-bars. The top bar is $\frac{7}{8}$ inch wide. Frames are suspended $\frac{1}{4}$ inch apart. This must be carefully followed. Proper spacing can be effected by fixing special removable metal cleats called 'metal ends' at the ends of the frames. Spacing can also be effected by using self-spacing frames. The self-spaced frames have wide shoulders at the ends. The same purpose will be served if small nails are hammered down to proper depths on the sides of the plain top-bars, at the two ends. The two side-bars of the frame may have wide edges at their upper ends (Fig. 32). But correct spacing by eye estimation is not difficult. Careless spacing induces bees to build extra comb in the space between two frames or between the frame and the side-wall of the chamber. These combs are called *brace-combs.* Combs built and raised up from the top-bars of frames are called *burr-combs.*

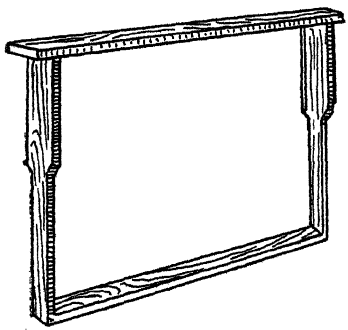


Fig. 32.
Self-spacing Frame.

Between the bottom-bar of the brood frame and the floor board, there must be a clearance of half an

inch. Between the top-bar of the brood frame and the bottom-bar of the shallow frame there must be a clearance of one-fourth inch. Any deviation will induce the bees to join together the two bars with propolis in case the space is less, or build combs in case the space is more. It has been observed by the author that whereas a clearance of half an inch between the bottom-bars of the brood frames and the floor board, kept for the free movement of the bees, does not induce them to build comb there, a similar space of half an inch between the bottom-bar of the shallow frame and the top bar of the brood frame gives them the opportunity to build comb here and join up the upper and the lower frames.

The Dummy or Division Board :—The 'Division-board' or the 'Dummy' (Fig. 33) which hangs in the brood chamber in addition to the frames, consists of a piece of wooden board $14\frac{1}{2}'' \times 8\frac{1}{4}'' \times \frac{3}{8}''$, fixed to a top-bar $17'' \times \frac{7}{8}'' \times \frac{3}{8}''$ for a standard-frame hive; and $8'' \times 5\frac{3}{4}'' \times \frac{1}{4}''$ fixed to a top-bar $9\frac{1}{2}'' \times \frac{7}{8}'' \times \frac{1}{4}''$ for a Newton Hive. Two battens are screwed vertically on the two edges of the board. Uniform with the tops of the brood frames, the division-board rests on the two grooves and hangs down in the chamber.

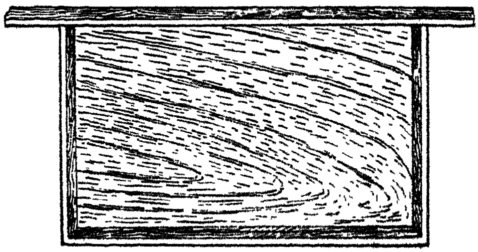


Fig. 33. Dummy or Division Board.

The space in the brood chamber can be adjusted with the aid of this dummy if it is not fully occupied by the combs, or when some of the combs are removed or when new frames are added. The dummy is helpful to bees in maintaining the hive temperature when it hangs beside the comb and thereby reduces the open space inside the chamber.

How the Hive should be : Accuracy in its Make :— Quality is the main consideration in the manufacture of hives. A great deal depends on the hive for successful bee-keeping. The hive should be such that the apiarist would feel pleasure in handling its parts and manipulating the bees. Its construction should be simple and the material best. All the parts must fit properly and the measurements followed accurately. In making the hives at home, the best course would be to get a good hive as a pattern. Seasoned teak wood is ideal for the work. Planks half an inch in thickness would do in making the body box, the super, the bottom board and the roof. (See 'Measurements', below).

Protective Paint and Colour Mark of Hive :—The exterior of the hives should be painted, so that they may withstand the effects of weather. The light blue colour or a mixture of light grey and blue may be used. Bees when taking flight, mark the location of the hive very carefully, come back to the hive and alight straight near the entrance on the alighting board. They sometimes fumble if the hives are placed very close to each other. Brood chambers having distinguishing colour-marks in the front

(Fig. 27, page 76), or hive fronts painted with different colours, help the bees in marking out their own hives. This should be done matching with the protective coat of paint of the hive.

The interior of the chambers as also the bottom board should have a thin coating of plain shellac polish, but not the frames and the inner side of the roof, and the ceiling if any. Hives in use, when become unclean due to the ravages of moths or on account of the accumulation of refuse matters and dirt, require to be washed and cleaned with water and sunned for some time, before they can be used again. A thin coating of polish inside, protects the wood against such washing and sunning.

Condensation of Water in Winter :—Sometimes moisture condenses on the walls of the hive and on the roof inside, in the winter. It trickles down and runs out through the hive door, over the bottom board This happens on account of the moisture contained in the warm air inside the hive coming in contact with the cold air. Condensation takes place on the underside of the cold roof as also on the inside walls. The underside of the roof, when left untreated with any protective coat, helps the absorption of the moisture to some extent. Proper ventilation helps to a great extent in preventing condensation in the moist climate of the Plains.

Some bee-keepers provide a flat ceiling which is a wooden board fixed to the roof inside, with a ventilator in the middle, covered with wire gauze. This ceiling is so fixed that the roof when placed in position on

the super, leaves one-bee space between the ceiling and the top-bars of the frames in the super. But the author has observed that this arrangement of a ceiling in the roof to shield the bees from cold, and to help them to maintain the hive temperature in the winter, obstructs the free ventilation which results in the condensation of water to a great extent. Much depends on the climatic condition of the place. For, condensation does not occur when and where the atmosphere happens to be quite dry. But it is clear that in order to prevent condensation the hive should be properly protected by thorough packing so that the walls and the inside of the hive may be kept warm and thus saved from the cold outside. (See 'Wintering' in Chapter - 9).

Measurements :—Measurements of frames and some of the parts of the hive are given below, without going into the full details of their manufacture. In making the body box, the super, the bottom board and the roof, planks half an inch in thickness will be quite good.

(1) **British Standard Frame** :— Brood frame measures 14″ long, 8½″ deep (end to end, including the thickness of the top and bottom bars), with top-bar 17″ long × ⅞″ wide × ⅜″ thick (Fig. 28, page 77). The shallow frame is 5½″ deep, other measurements are the same as that of the brood frame (Fig. 29, page 77).

Brood chamber for holding 9 British Standard frames, measures internally 16½″ long, 9″ deep and 12½″ wide. It is 16½″ wide to hold 12 frames. Thus the 12-frame hive is exactly a square, with this

additional advantage that the frames can be suspended both parallel to the entrance and at right angles to the entrance as desired by the bee-keeper.

The shallow chamber is 5¾″ deep, other measurements remaining the same as that of the brood chamber.

The bottom board measures 22″ long and 13½″ wide for holding a chamber for 9 frames. It is 17½″ wide for a 12-frame chamber.

Hive entrance is 9″ wide and ¼″ high for the former, and 12″ wide and ¼″ high for the latter.

(2) **Langstroth Frame** :—The Langstroth frame which is in use in America, has the following dimensions: Bottom-bar 17⅝″ long × ⅜″ thick; side-bars 9⅛″ long × ⅜″ thick; top-bar 19⅛″ long × ¾″ thick.

(3) **Modified Dadant Frame** :—The size is the same as that of the Langstroth frame, except that it is 11¼″ in depth.

(4) **Newton Frame** :—The brood frame measures 8″ long, 6″ deep (end to end, including the thickness of the top and bottom bars), with top-bar 9½″ long × ⅞″ wide × ¼″ thick (Fig. 30, page 81). The shallow frame is 2½″ deep, other measurements are the same as that of the brood frame (Fig. 31, page 81).

The brood chamber measures internally 9″ long, 6½″ deep and 9½″ wide for holding 7 frames. The shallow chamber is 2¾″ deep, other measurements remaining the same as that of the brood chamber.

The bottom board is 14½″ long and 10½″ wide. The hive entrance is 6″ wide and ¼″ high.

(2) **Bee Veil and** (3) **Gloves** :—The bees have a peculiar habit of thrusting their stings specially on the front part of one's head,—the forehead, nose, eyelid, cheek, chin and ear. Then again, when pressed carelessly by the finger-tip in manipulating a comb, the bee is sure to thrust the sting there. Bees sometimes crawl over the face and hands during the manipulation. The tickling sensation on the skin may not be very pleasant, and when the hands are engaged in holding a comb full of bees, the involuntary and sudden movement of the body caused by such a tickle may frighten the bees resulting in an attack from them. The bee-veil should be used for the protection of the face, and so far as a beginner is concerned, the gloves for the hands should be used.

Net Veil.

The veil can be made of a fine black net, with a tape run in at the upper end and fitted round the crown of a hat. A piece of elastic round the lower end of the net will close round the neck and prevent the bees from crawling in. White nets obstruct clear

vision. But a veil can be made of white net with a piece of black net stitched in the centre and the white netting of that portion removed. (See 'Use of Veil in Bee-keeping', Chapter - 38). Another veil known as the 'Wire Veil' made of copper wire-cloth is also in use, one pattern of which has a folding arrangement.

Gloves though somewhat clumsy and to some extent a hindrance in the proper manipulation of combs and in the delicate handling of the bees, give security to the beginners. But they are unnecessary for daily work and should be discarded as soon as one is able to handle bees with confidence. The graceful handling of the bees with bare hands is only a matter of practice, and a beginner is sure to learn it in no time. Gloves are useful when a beginner is to shake off bees from the combs and the bees happen to be in an irritable temper.

Bees love their brood and are very much attached to them. The removal of bees from the brood comb causes irritation because they do not like to be separated. Their resentment is manifest when we find them thrusting their stings as they are thus shaken off.

There are costly bee-gloves made of thin, soft, white leather, as also fabric-gloves specially treated, and gloves made of layers of rubber and cloth. Ordinary thick rubber gloves as are used by the medical students in dissection, will do. Gloves give protection in the sense that if stung, the sting does not enter the flesh. The sting must be immediately removed from the gloves and the hand dipped in water

with the gloves on, and then ammonia applied to hide the smell of the sting. For preventing the bees from getting up the sleeves of the coat, these can be folded round the wrist and clipped with a pair of ordinary trouser-clips or fastened with a pair of rubber bands. Rubber gloves are costly and in their place thick linen gloves or woollen gloves may be used.

(4) **The Smoker** :—The smoker consists of a cylindrical fuel box made of a piece of galvanised iron

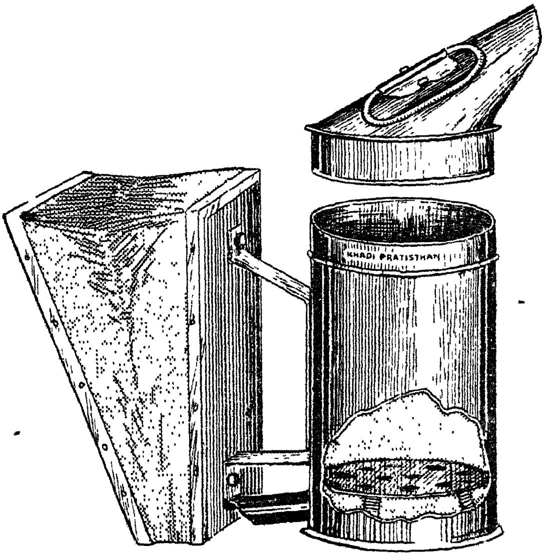


Fig. 34. Smoker.

sheet, connected with bellows for blowing air. The fuel box has got a removable grating at the bottom, and a removable bent nose at the top, through which the smoke comes out (Fig. 34). A piece of clean rag

when burnt in the fire box will send forth a volume of smoke through the nozzle by pressing the bellows. The smoker is made such that when standing straight up with the nozzle, it will draw fresh air automatically and keep the fuel burning. The smoker should be placed on its side to extinguish the burning fuel. Cocoanut-husk as a fuel has been found to be highly satisfactory. Paper rolled or twisted and sacking may also be used.

The smoker is intended for subduing the bees. A few puffs of smoke blown into the hive will throw the bees into a commotion and being frightened, they will gorge themselves with honey stored in the cells. In that condition they remain quiet and are not inclined to sting except under strong provocation. The thing is that for thrusting a sting the bee has to curve her abdomen, and when the honey-sac has become full with honey by the adoption of the artificial method of frightening the bees with smoke, the abdomen being distended, it becomes difficult for the bee to curve the abdomen and thrust the sting. It must be understood that smoke does not directly throw the bees into a lull but works indirectly as stated above. Smoking, when overdone, will cause suffocation and death. One must, therefore, be very careful in applying the smoke.

European Bees are said to be more peaceful and less prone to stinging than the Indian Bees, yet for opening a hive the European bee-keeper has first to subdue his bees by blowing one or two puffs of smoke into the hive through the entrance and through

the top. Here, in India, smoking is not at all necessary for opening the hive and handling the combs, except for a stock which has been found to be very vicious.

The smoker may be used in certain circumstances in capturing wild colonies (see 'Driving out Bees from Cavity' in chapter-10), and also for uniting a queenless colony with a queen-right one or for uniting weak stocks. (See 'Uniting Stocks', Chapter-21).

(5) **The Feeder** :— Bees have got to be fed artificially when the stored honey in the hive runs short. Feeders are, therefore, necessay to supply food to the bees in the proper place and in the proper quantity. The food must always be given inside the hive. Shortage of food can be detected simply by passing a glance over the combs when lifted from the chamber. Wild colonies when captured require close feeding for a few days. Stores usually run short during the rainy season. (See 'Honey-bees and Rainy Season', Chapter-36). Hives must be examined from time to time till the next flow comes. Hungry bees become very ferocious. The scarcity of food leads them to robbing, and starvation compels them to abscond. (Details about 'Feeding the Bees' have been given in Chapter-12, and about 'Robbing and Fighting' in Chapter-19).

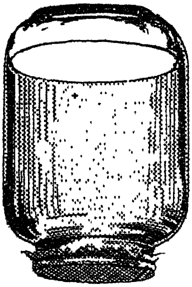


Fig. 35.
Bottle Feeder.

There are various designs of feeders for regulating the flow of the artificial food supplied. An ordinary

wide-mouthed bottle of one pound or twelve ounce capacity will serve the purpose. A piece of clean cloth tied over the mouth, and the bottle inverted and placed upon the frames will do (Fig. 35). For regulating the flow, coarse or closely woven cloth can be used. For rapid or slow feeding, two or more layers of cloth can be tied round the mouth of the bottle as required.

Another feeder known as the 'Division Board Feeder' is a trough made of wood which occupies the space of an ordinary brood frame, and has shoulders at the two ends so that it may be inserted in the brood chamber and placed like an ordinary frame in any desired position. It is fitted with a wooden float which gives the bees the necessary foothold to suck the syrup. As the syrup is consumed the float goes down keeping level with the column of syrup in the trough. The trough may have a tin lining to prevent leakage. Feeders as these having half the breadth of the Langstroth frame; are used by some bee-keepers in the Hills.

(6) **The Penknife and** (7) **the Scraper Knife** :—The *penknife* is an all-round useful article for the bee-keeper. It may be taken as the first requisite of the bee-keeper and a constant companion when with the bees. The *scraper knife* (Fig. 36) is also a handy article

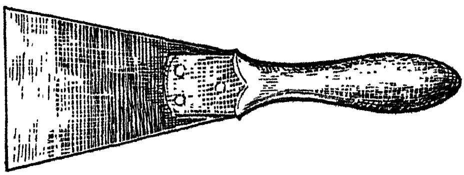


Fig. 36. Scraper Knife.

in the apiary for cleaning the floor board and scraping the parts of the hive and the tops of the frames.

(8) **The Hive Tool and (9) a pair of Scissors :**—The *hive tool* (Fig. 37) is designed to be useful for a lot of purposes. It makes a very efficient scraper when the burr-combs are to be removed from the tops of the frames, or some other parts of the hive are to be scraped. It also serves as a handy lever to raise the hive-top or the shallow chamber when they are held fast with propolis.

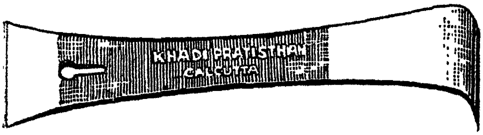


Fig. 37. Hive Tool.

A pair of *scissors* is required to trim or remove by cutting out any thread or fibre and to pare off such other things.

(10) **The Screw Driver, (11) a small Hand-drill and (12) a pair of Pliers :**—These are most serviceable articles. The *pliers* and a small *hand-drill* will be necessary for wiring the frames, (See 'Wiring the Frames' below). With the increase of the size of the apiary a few more of the carpenter's tools will be required.

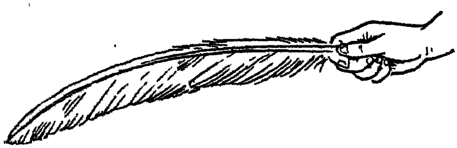


Fig. 38. Feather.

(13) **The Feather :**—The feather (Fig. 38) is very useful for brushing off bees from the combs, for

cleaning the alighting board and other parts of the hive, for lifting the young bees from the ground to the alighting board, and in several other ways. It should be large and strong.

(14) The Frame Stand:—The frame stand (Fig. 39) is to hold frames and combs. While examining a colony it often becomes

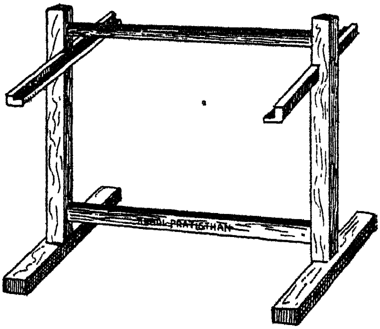


Fig. 39.
Frame Stand or Comb Stand.

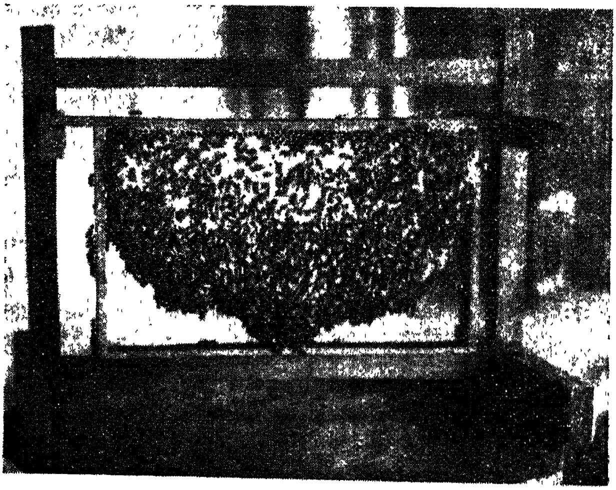


Fig. 40. Grub Comb on a Frame Stand.

necessary to remove one or more combs from the hive. A stand placed near-by will be very helpful (Fig. 40).

For the extraction of honey, combs removed from the hive can be kept hanging on the stand in the extraction room. An extra brood chamber may also come to the aid.

(15) **The Hive Stand** :—In order to avoid moisture from the ground and contact with weeds, it is advisable to keep the hives on stands (Fig. 41). Instead of permanently nailing four legs to the bottom board of the hive for this purpose, it is better to leave the bottom board free.

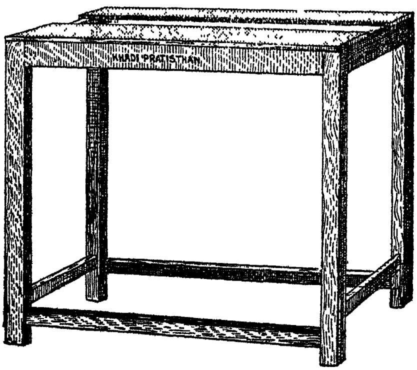


Fig. 41. Hive Stand.

As the legs of the stand are to rest in cups full of water, it is better to make them rot-proof, for which about 2 inches of each leg from the bottom, should be dipped in melted hard-paraffin.

The hive stand can easily be made at home. Its legs should be 15″ high so that a bee-keeper can conveniently manipulate the hive without putting too much strain on his waist. An ordinary stool can take the place of a stand in case of an emergent need.

(16) **The Swarm Catching Net** :—For securing a swarm or a cluster of bees the swarm-catcher (Fig. 42) is indispensable in an apiary. It consists of a strong mosquito net, stitched like a pillow-case, 21″ long and 18″ wide, with one mouth open. The open mouth is to be secured round a strong wire-loop, 11″ in diameter, and the open end of the wire to be fixed to a round handle made of wood or bamboo about an inch in diameter and 21″ long.

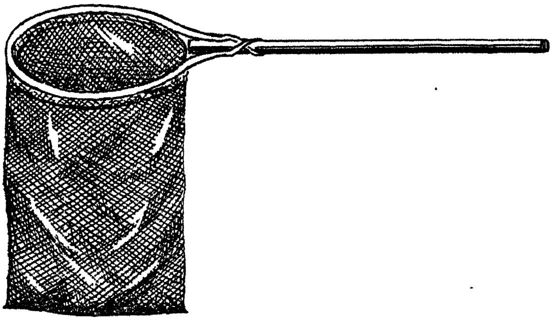


Fig. 42. Swarm Catcher.

For capturing a swarm, slowly and very carefully raise the loop up just to touch the bees in such a way that the position of the cluster be in the centre of the loop or as close as possible. With a quick pull draw the handle to any side that may be convenient. The bees thus dislodged will fall directly into the net with a thud. Quickly turn the handle raising up one side of the loop, when the open mouth of the loop will be closed and the bees will be trapped and will find no way out. Close to the rim, fasten the

net with a piece of twine so that the bees may not push their way through.

If some of the bees have been left out on account of the bad position of the cluster or bad manipulation, and if by chance the queen has not been netted and left out along with those few bees, a second cluster will immediately be formed at the same place or at a place near-by. The second cluster should also be caught in a second net similarly and secured as before. If the queen had been caught in the first net, the few bees that were left out would soon come back and sit on the net. This returning of the bees of their own accord was a sure indication that the queen was inside the net.

(17) **Earthen Plate** :—Earthen plates are necessary in order to place them under the legs of the hive stand. These are to be kept filled with water. This is to prevent ants from running up and entering the hives. Any other sort of dish or cup may be used if convenient.

(18) **The Honey Extractor** :—The honey extractor is for the extraction of honey without injuring the comb (Fig. 43). It consists of a tinned iron drum with a bottom like an inverted funnel. Inside the drum is a cage made of wire-netting with a rod in the centre, having the lower end pivotted in the centre of the bottom, the other end passing through a cross bar at the top of the drum, secured to its sides. The cage is fitted with a gearing and can be rotated at a fair speed by a handle at the top.

The combs are placed tangentially in the cage, after they are uncapped. When the cage is set in

motion by turning the handle, honey is thrown out of the cells by the centrifugal force. It trickles down the side of the drum and accumulates at the bottom and can be drawn off through an opening or a tap at the bottom. When one side of the comb is extracted, it is then reversed for the extraction of the other side. A few turns of the handle will be sufficient to extract one side fully.

An extractor will take four shallow or two deep frames at a time. They are also made to take more than two deep frames. There are various designs of hand-driven extractors fitted with cog gearing and ball-bearings at the top and bottom. There are extractors that can take 20 Standard shallow combs or 12 shallow and 8 deep combs radially at a time. Larger radial extractors, driven by power, are in use in America and in Europe, carrying 50 combs. This gives an idea of the extent of work done by big bee farms in those countries.

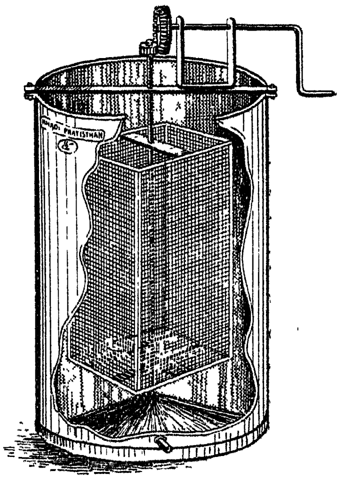


Fig. 43.
Honey Extractor.

Wiring the Frames :—The extraction of honey brings us to one important thing which is the wiring

of the frames. Usually during the honey flow season, the two side-combs in the brood chamber contain honey exclusively. These can be extracted if so desired. Unless the frames are wired, there is every probability of the comb breaking down on account of its weight while 'jerking' or 'thumping' the bees off from the comb, or while being rotated at a fair speed in the extractor.

Wiring fastens the comb securely to a frame. It makes the comb strong and prevents it from sagging when the heat inside the hive, specially the excessive heat in April, softens the wax, and the weight of the brood, the adhering bees and the honey in the cells tend to press the comb down. Wiring prevents the comb from breaking, if carelessly handled. The removal of the bees from the combs will be risky if the frames are not wired. In the usual course of adding frames, as the population of a colony increases, it is better to have the frames wired first and then given to the bees with comb-guide or foundation.

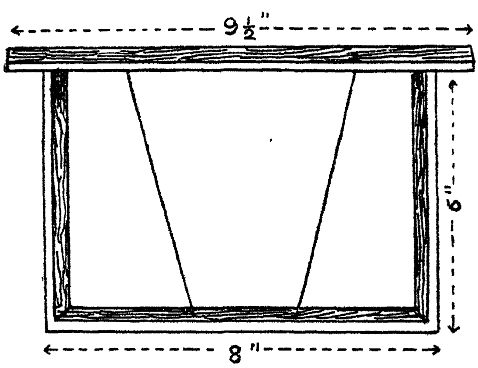


Fig. 44.
Method of Wiring a Newton Brood Frame.

The Newton frames can be wired in 'V' shape (Fig. 44). The bigger frames can be wired in the shape of 'X' with two vertical wires on the two sides, two inches off from the side bars (Fig. 45). One single piece of wire should pass round to make the wiring complete. Holes should be bored in the top and bottom bars in their proper places to pass the wire through.

In order to wire the Newton brood-frame as shown in Fig. 44, pass the two ends of the wire first through

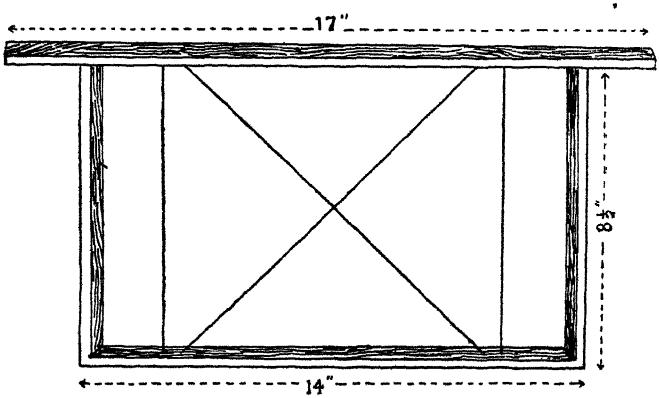


Fig. 45. Method of Wiring a Standard Brood Frame.

the two holes in the bottom bar, next through the two holes in the top bar, and then back again down through the top bar by two other holes bored very close to the former ones. Now fasten the ends by winding them round the two upright wires.

The wire should be stretched tightly with the help of pliers, before the ends are secured by twisting.

Tinned wire No. 30 is suggested for the work. If that is not available, ordinary thin galvanised wire may be used.

Use of Comb-guide :—When the frames are given to the bees for comb building, small pieces of combs of the size of about 3″ × 2″ cut off from a comb of full size or small pieces of brace-combs, are generally fixed to the underside of the top bars of the frames with twine. They serve as guides and the bees start work. These small combs are thus called 'Comb Guides' or 'Starters'. And starting with a small piece, the bees cover gradually the whole length of the top bar and fill up the frame. Bees generally follow the course of the bar, but the combs are often built out of line, and the result is the formation of irregular combs joined here and there to the combs beside.

Use of Comb Foundation :—In order to avoid the difficulties as stated above and to get straight combs, built uniformly within the frames, and to save the bees to a great extent from secreting wax, as also the time and labour for such secretion, comb foundation (Fig. 46) is the thing necessary. Comb foundation was first invented in 1857 by J. Mehring of Frankenthal, Germany. His product was somewhat of a crude nature. Improvements upon this were then made in America. And in 1875, A. I. Root of Medina, Ohio, U.S.A., in collaboration

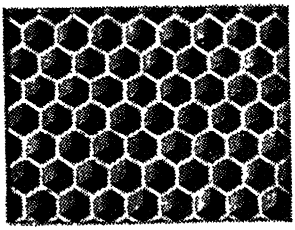


Fig. 46. Comb Foundation.

with his friend, A. Washburn, constructed a foundation-mill having embossed rollers, through which a thin sheet of beeswax, when passed, produced the desired foundation, impressed with the shape of the base of the natural cells.

The manufacture of comb foundation has been perfected. The size of the cells are as true as made by the bees themselves. For building the combs, the bees have to draw out the cell-walls on these foundations and to secrete wax for this purpose only. Foundations of various sizes, differing in thickness and in the size of the cells, are available. The frames can now be fitted with 'medium' or 'thin' sheets of foundation for brood rearing, having respectively 8 and 9 sheets to a pound for Standard frames.

The foundations, when fixed to frames, should preferably be in full sheets. Brood foundations can also be used in the super. When the full sheets of worker-base foundations are given to the bees, they build generally all worker cells. The use of full sheets also helps to control the rearing of drones, for, during the swarming season when half sheets are used, exclusively the drone cells are often built in the lower portions of such foundations.

No drone foundation need be placed in the brood chamber for drone rearing. Patches of worker brood are interspersed with drone brood as can be recognised by the raised heads of the cells containing the latter brood. And then, during the season when the full sheets of worker base foundations are given to the bees for increasing the brood nest, the bees on their

own impulse make necessary alterations in the foundation and provide for drone-breeding.

One has got to be very careful in selecting the proper comb foundation, for, the cell-sizes of the Hill type and the Plains type of the Indian Bee differ. The size of the cell of the European Bee is also different. (See 'Size of Cells', in Chapter - 30). The Plains type of Indian Bees have 6 worker cells to the lineal inch, whereas, six worker cells of the Hill type measure $1\frac{1}{16}$ inches. And it has been found that an empty comb from a Hill type colony having worker cells, when introduced in a Plains type colony, induces the queen of the latter to lay drone eggs—the size of the worker cells being bigger. It should be noted that the sizes of the worker cells of both the Plains and the Hill type of bees differ slightly from place to place.

The foundations must be made of pure beeswax. Those made from adulterated wax will not stand the hive temperature. Old foundations change colour. Combs and comb foundations become brittle when kept in stock for a long time, and this defect can be remedied by exposing such combs or foundations to the sun for a few minutes. It has been found that bees tear down the brittle cell-walls leaving only the midrib and cell-bases when such combs are given to them for increasing the brood nest.

Comb foundation sheets suitable for Apis Indica of the Plains type, can be had of the Imperial Entomologist, Imperial Agricultural Research Institute, New Delhi, at about Rs. 1/8 per lb. (Pre-war price is noted here). The Entomological Department

of the Government of the Punjab, Lyallpur, also makes comb foundations having 21 cells to 4 lineal inches ; these are available at about Rs. 1/12 per lb. (pre-war price), enquiries for which should have to be addressed to the Director of Agriculture, Punjab, Lahore. The Coorg Honey and Wax Producers' Co-operative Society Ltd., Virajpet, Coorg (India), make comb foundation, and there may be others who are also manufacturing the same.

Home-made Foundation :—One can make his own comb foundation. With moulds of Paris Plaster taken from a good comb foundation, sheets of wax can be embossed producing a replica of the pattern from which the moulds have been made. The wax-sheet should have to be dipped in warm water and thus softened, before it is being embossed by pressure applied to the mould. Here is a brief description.

In order to make a mould as above, get two wooden frames so that the pattern-foundation may be placed inside the frame and fit accurately. Fix two pairs of hinges such that the two frames may open and close freely like the lid of a box. This is to ensure accuracy in the position of the moulds which are to be cast in the two frames, representing the two faces of the pattern-foundation. With a proper contrivance, keep the pattern just in the middle of the frames and let one face of the pattern rest on a board in that central position, in the frame. Keep the open face of the pattern up.

Make a soft mixture of Paris Plaster and water, and hurriedly spread it over the pattern with the

aid of a small trowel. Press down the plaster so that there may not have air holes in the depressions of the pattern. Plaster of Paris sets like cement when mixed with water, and it sets quicker. Therefore, small quantities should have to be mixed at a time and spread over. Fill solidly upto the upper edge of the frame. Now turn the frame over, remove the board on which the pattern was resting, and cast the other face also. Twenty-four hours after, open out the frame carefully on its hinge, and the two moulds will be found enclosed in the two frames. Now remove the pattern-foundation bit by bit with the aid of a penknife or any sharp point, for, the pattern will be found fixed to the mould, with some portion to one face and some to the other. When that is removed, the mould will be ready to take a sheet of wax to be embossed.

The author has prepared comb foundations in his moulds made of Plaster of Paris in the way described above. When these foundations were given to bees, they responded well though the impressions on the sheets were not sharp. Bees got the cell-bases marked, and did their part of the work in building the foundations to perfect combs. With the Paris Plaster mould, the difficulty was that full pressure could not be applied, and that the raised portions of the mould came off from time to time as the sheets were embossed.

Cement sets hard and takes appreciably more time to set. This is an advantage in handling the soft mass of cement for the pattern to be filled with, and

the mould made. Cement moulds were then made and full pressure was applied. The foundations thus made were given to the bees and they worked equally well. But sharp impressions could not be got, because with cement, sharp moulds could not be made. A mixture of cement and Plaster of Paris was also tried but it did not improve the position much.

Electroplates were next made suitable for the Newton size of frames, filled with lead at the back, mounted on wooden blocks and pressure applied with a lever. This machine worked quite well. The wax sheets were successfully embossed and they gave as much satisfaction as they could possibly do, compared with those produced by the roller-mills. The machine is so arranged that the plates can take wax sheets of any thickness and adjust themselves automatically and uniformly. It is in use at Sodepur. The foundations made with this machine are being used in the Sodepur apiary. These foundations are also available for sale, enquiries for which should be addressed to the Secretary, Khadi Pratisthan, Calcutta. For the foundation of Standard size, the cement plates are still being used and they are giving a very valuable service now when the transport of articles within the country has been restricted both by rail and by post on account of the abnormal conditions due to war through which we are passing.

Now, as to the wax sheets. These are made by dipping a piece of board, ¼″ in thickness, in melted wax and then lifted and dipped in cold water. Two sheets separate out from the two sides of the board as

soon as it is placed in the water. To get uniform sheets, the board is dipped twice in the melted wax, and while so doing the ends of the board are reversed. The thickness or thinness of the sheets depends on the temperature of the melted wax and the number of times the board is dipped in it.

The wax should be melted in steam bath. Before proceeding to dip the board in the melted wax, the board should be kept in cold water at least for an hour so that it might have a thorough soak. This would prevent the melted wax from sticking on to the board. The first few sheets may not be satisfactory, but as experience is gained, good sheets will be coming out soon. A teak wood board would serve well.

Fixing the Foundation : the Wiring Appliances :— When the foundation is used, certain appliances are necessary for fixing it in the wired frame. These consist of a Fixing - Board (Fig. 47) on which the foundation is to be placed, and over the foundation the wired frame is to rest. The next appliance required is the Wire-Embedder for embedding the wire in the comb

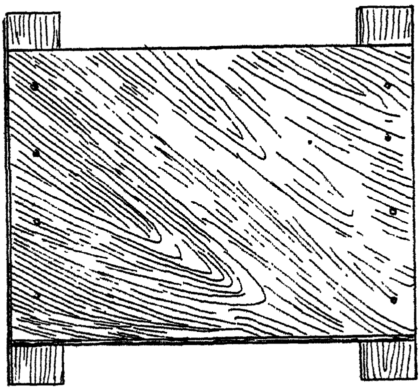


Fig. 47. Wire Embedding Board.

foundation. Generally the Spur-Embedder is used (Fig. 48). There is a groove on the face of the revolving toothed wheel of the embedder. The embedder should be mildly heated, and while hot, the toothed wheel should be drawn along the wire of the frame for embedding.

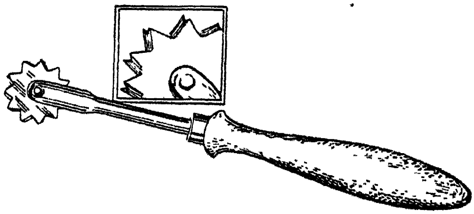


Fig. 48. Spur Wire-embedder. The groove on the face of the toothed wheel is shown in the inset.

The tinman's ordinary axe-shaped soldering-bit of copper, of a very small size, is quite handy and satisfactory as an embedder (Fig. 49). A shallow groove shall have to be cut on its thin face with a triangular file. For heating the embedder, a small spirit lamp serves well, and the copper bit retains heat prefectly. Starting from the far end of a wire the heated embedder should have to be drawn along it by the operator towards himself, gently pressing the embedder down, the groove serving as a guide (Fig.50). The hot embedder will melt the foundation along the wire, and the wire will be embedded as quickly as it is drawn. Too much pressure on the wire,

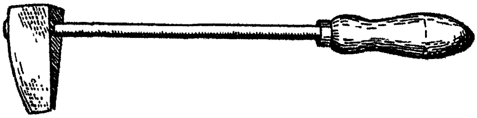


Fig. 49. Axe-shaped Soldering-bit of Copper as Wire-embedder, with its face grooved. The groove is shown here.

and overheated embedder will melt the wax through, making holes, and will spoil the foundation along the line over which the embedder is so drawn. In an inexperienced hand the embedder is likely to go off the wire here and there having missed the groove. The work will become easier and satisfactory after a few sheets have been embedded.

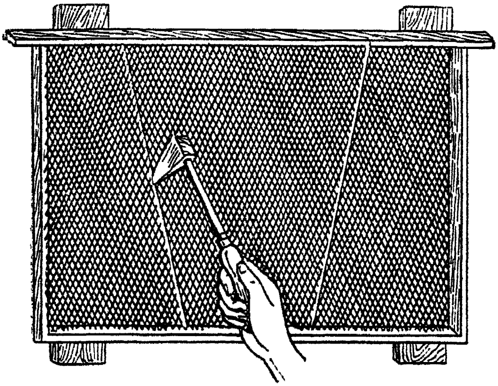


Fig. 50.
Wire-embedder in use,
Embedding wire into comb foundation.

Electric-embedders are also in use. Wired-foundation of various types is also supplied by different makers in other countries.

(19) **Uncapping Knife** :—For the extraction of honey, the sealed combs have to be uncapped. This is

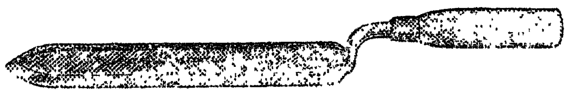


Fig. 51. Uncapping Knife.

done by the Uncapping Knife (Fig. 51). It has sharp bevelled edges, and the handle is slightly raised like a trowel. A knife 12″ long including the handle, with a blade 7″ long and 1″ wide, weighing not more than

four ounces, would be suitable. Any blacksmith will be able to make a knife like that. While operating, two knives will be required which must be kept hot by dipping them in hot water, and used alternately as one cools down. For opening out the closed cells, pass a hot knife just below the cappings and shave off. Cappings will come out in thin sheets.

(20) **Uncapping Tray** :—It consists of one outer tray made of a tin sheet, 15½″ long, 10″ wide and 2″ deep. A thick wire passes round the upper edge of the tray leaving four small loops at the corners. Inside

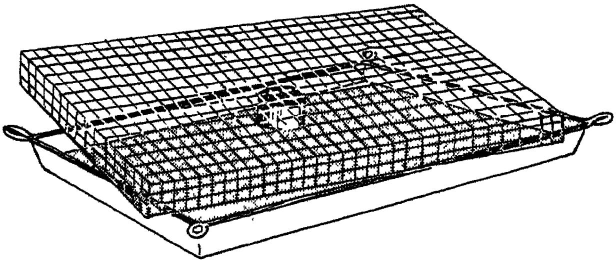


Fig. 52. Uncapping Tray.

the tray loosely fits another tray made of galvanised wire-netting, four lines to an inch, with the bottom up (Fig 52). The net takes the cappings as they fall from the uncapping knife, and the honey contained in the cappings drains down into the tray.

The tray can also help in the extraction of honey from a few combs occasionally, without the help of an extractor, for the details of which, see 'Extracting Honey Without Extractor', Chapter - 37.

(21) **Queen Excluder** :—The queen very rarely goes to the super for egg laying, but she may be excluded

by the use of the Queen Excluder (Fig. 53), and kept confined in the brood chamber. The excluder is made of a piece of zinc sheet having long slots through which the workers can pass but not the queen. An excluder interposed between the super and the brood chamber shuts off the queen from visiting the super and thus prevents her from laying eggs in

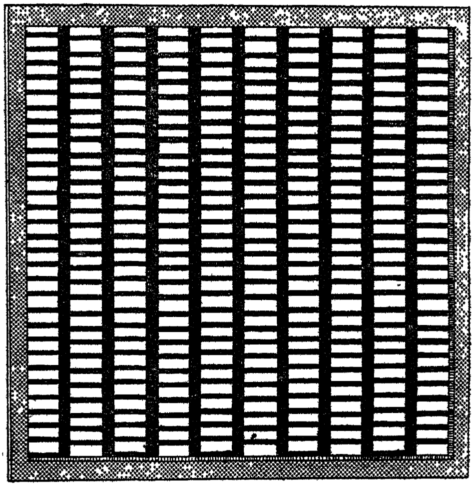


Fig. 53. Framed Queen-Excluder, Zinc.
To prevent the Queen from
reaching the Super.

the shallow combs. The excluder should be large enough to cover fully the top of the brood chamber and should be so framed and placed that a clear bee-space of ¼" is left between the zinc sheet and the top bars of the brood combs, and that the slots run across the frames and not parallel.

8

There are various patterns of excluders offered by different makers. An excluder can be made at home from No $4\frac{1}{2}$ long-slot screen.

The Division Excluder:—In order to keep the queen confined to a definite number of combs in the brood chamber, the division-excluder is very useful (Fig. 54). Such an excluder can be made out of a piece of zinc-excluder sheet, cut to size and nailed to a deep frame or to a top bar. It should hang in the brood chamber like a division board, thus excluding the queen without obstructing the free movement of the workers. (See 'Standard-frame Hives and Supering' in Chapter-14).

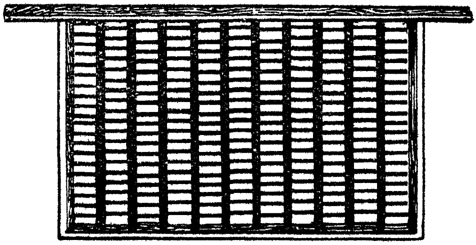


Fig. 54. Division Excluder.
To confine the Queen to a definite number of frames in the brood chamber.

CHAPTER IX

ARRANGING AN APIARY

Bees are found everywhere in India, more or less. Being an agricultural country and being full of wild nectariferous plants and trees, India is the place for bee-keeping. The presence of wild bee-colonies in a place indicates the bee atmosphere. A search in the neighbourhood will meet with success in finding out the right type of bees for hiving. A general survey will give an idea as to the nectar-yielding plants that exist in a particular area. But the suitability of a location can only be found out by keeping a few colonies of bees unless it is already known. A good location is undoubtedly the first requisite for an abundant supply of surplus honey for the bee-keeper.

Position of the Hive :—The Indian-bee wants a hollow space kept out of sun and rain, for a natural home. Therefore, in selecting the position for an apiary, one shall have to find a place suitable for the bees. A covered shelter without having any obstruction to the flight of the bees would be best. Bees when they become accustomed to seeing persons pass by a path in the front of their hives a few feet away, will behave better than if they are situated in an unfrequented place. Hives placed at about 15 feet away from a path in one's own compound, and about 100 feet away from a public road, screened off by a hedge, may be considered to be at a safe

distance. A fencing of shrubs or a hedge of plants about 6 feet high, a few feet off from the hives, will serve as a protection, because bees will be taking their flights over the hedge and the fencing.

'Antigonon' is a common garden climber. It has showy flower-clusters of pink colour which contain nectar and attract the bees. 'Aparajita' (*Clitoria Ternatea)* has nice blue flowers without nectar or pollen ; but it is a good climber. These may be planted beside the fencing to serve the purpose of a screen. Plants of 'tree-cotton' grow well, and can be trimmed to size and shape. A line of tree-cotton will make a good hedge and will supply nectar and cotton both.

These hedges and fencings also protect the hives from the cold wind in winter blowing from the north. An apiary, surrounded by trees on all its sides forming an enclosure, is ideal. Trees placed at a distance, on all sides of the bee yard, serve as wind-breaks.

A couple of hives can safely be placed in one corner of the verandah of a dwelling-house or any outhouse. The ground near the hives all round should be kept free of weeds. Thatched sheds should be constructed where necessary. One may be tempted to place the hives under a shady tree. But this must not be done. Leaves will fall on the ant-preventing water-pots and will make a good bridge for the ants to cross the water and reach the hive. That was the sad experience of the author when a colony of bees was thus attacked by red and black ants. The bees were struck with terror as the ants came in numbers. There was a tremendous fight. But the ants got the

upperhand. In spite of all efforts the colony could not be saved because, the brood and honey, by that time, were all in a mess. There was a wail all round the hive when the combs were under examination, and ultimately the bees decamped leaving the bee-keeper only to thank himself for the disater.

Hives should be so placed and so protected that they may not be disturbed or thrown down by cattle or any other domestic animal. Children should also be given a warning against their pranks.

Necessity of Shade :—Hives in the Plains should never be kept in the open. The scorching rays of

Fig. 55. A Corner of Sodepur Apiary, 1938. Hives in the open yard, had to be removed to covered shelters.

the sun and the excessive heat in the open affect the bees adversely. It has been found that when hives are so kept in the open, the bees after abandoning the

combs due to heat, huddle together in a corner inside the hive; they sometimes take shelter underneath the bottom board being unable to withstand the suffocating heat inside. The combs sag, and the queens die; the grubs wriggle out and the pupæ dry up

Fig. 56. Bee Avenue: Sodepur Apiary,
Where Gandhiji used to take his morning and evening strolls during his stay at Khadi Pratisthan, Sodepur, in April, 1939.
Hives had to be removed afterwards to covered shelters on account of the excessive heat in the open yard.

in the cells. The short span of life of the bees is further curtailed due to exhaustion. Their tremendous efforts in fanning fresh air inside the hive in such a heat, after spreading themselves on the alighting board and on the lower portion of the brood chamber

near the entrance, make a sound that resembles the muffled noise of a blower running close by. This undue strain and the unnatural condition make the bees desert their hives.

Following the suggestion that where proper ventilation is provided, "there need not be any shade against the sun", a few hives were kept at Sodepur in the open as an experiment (Figs. 55 and 56). But the bees could not stand the heat as stated above, and they did not fare any better through the rains and the winter.

Hive Space :—A space of 10 feet between any two hives is a fair distance when placed side by side.

Fig. 57. A Corner of Khadi Pratisthan's Apiary at Sodepur; Row of hives placed on stands, 5 feet apart.

Hives may be placed even 5 feet apart in case of emergency, though it leads to congestion (Fig. 57).

But for unhampered work, it is better to leave as much space between the hives as is possible for the bee-keeper.

There should be a clear space of about 4 feet at the back of the hive to enable the bee-keeper to move freely, leaving the entire front to the bees. This clear run of space behind the hives is essential for quick and easy manipulation.

Hives may be arranged in rows, one behind the other, facing in the opposite direction. And when parallel sheds are constructed to place the hives in, a space of at least 15 feet must be kept open between the sheds for the free flight of the bees.

Direction of Hive Face :—It is advisable to have the hives, in the Plains, face as near as possible the north-east, with a clear flight for the bees. Hives may be placed facing in any suitable direction that the bee-keeper may provide if they are sheltered from the morning and afternoon sun and protected by wind-breaks. In the Hills the bee-keepers prefer to have their hives face east so that the morning sun may give warmth to the hive and induce the bees to start work early. But in the Plains the direct rays of the sun, even in the morning, make the bees uncomfortable. As to early work in the hives facing north-east in the Plains, the bees in some places may be seen coming back with their loads at 5 A.M. in the summer and even earlier, and at about 6-30 A.M. in the winter.

In the Plains bees do not need any extra warmth requiring the hives to face direct east. They rather

require protection from the glare and the heat. Hives under shed having all the four sides open, when placed facing south, will be exposed to sun in the afternoon, and if they face west, the rays will fall directly on the entrance and the heat will be too much for the bees.

Quilting :—When there is an unusual cold in the Plains in the winter, quilts are placed over the frames occupied by bees inside the hive, which help them to preserve the hive-temperature. A clean piece of cloth is double-folded and placed over the top bars of the frames, covering them fully. The folded cloth should measure the space occupied by the top bars as also the top of the dummy board if any. In order to quilt, roll the piece of cloth, place its open ends on the frames and then unroll it fully and evenly. Before placing the quilt, drive the bees down from the top bars by blowing air.

A hole of about 3 inches in diameter may be cut in the middle of the quilt for feeding through. The hole should have to be closed again with the cut piece of the quilt after the feeder is removed.

One should be very careful in removing the quilt in order to examine the hive, because bees often fix the quilt with the top bars, with wax and propolis. At a morning temperature above 50° F. (10° C.) in the shade, quilting is not needed. Felt quilts, cork-dust quilts, improved hair quilts, glass quilts and ticking quilts are also used by bee-keepers in different countries.

Wintering :—Bees in winter get together in close cluster between the combs in order to keep themselves

warm and dry, and they require sufficient food to pass through. During the cold weather they should be disturbed as little as possible. In the Hills an average colony of bees on Langstroth frames would require about twenty-five pounds of honey to pass the winter. When the store of honey falls short of their requirements they should be fed to make up the shortage. Colonies on British Standard frames would require proportionately less feed.

Bees should be prepared for the winter and their feeding finished in time. The stocks should be kept strong so that the hive-temperature may be easily conserved, for, bees themselves serve best as their own winter packing. Weak colonies should be eliminated by uniting them with stronger stocks, or strengthened by uniting two or more such colonies together after the unwanted queens have been removed. (For 'Uniting Stocks' see Chapter - 21). Hives should be kept free from damp and protected from cold winds. Proper ventilation should be looked after, and the size of the entrance contracted to some extent. Empty combs not covered by bees should be removed and the division board brought close to the last comb. Layers of thick warm quilts should be laid over the frames.

Adequate protection must be given to the bees where the cold is severe. The empty space within the hive, between the division board and the hive-wall, should be packed with crumpled paper so as to retain the heat. The open space underneath the hive-stand should be packed with dry grass or straw. The hive all round should be similarly packed, and covered with

old sacking, keeping the entrance free. In order to give extra protection and warmth inside, some bee-keepers prefer double-walled hives. In place of a double-walled hive when an outer wooden case is used for packing, an intervening space of at least three inches all round, must be provided for between the outer case and the body-box, and empty space packed with chopped dry grass or straw. Over the sacking or the outer case, the hive top should have a waterproof canvas or a tin covering to drain off the water.

One must see that the hive entrance is not closed or obstructed by dead bees and snow. To avert the risk of snow, a piece of board should be placed in a slanting position against the front wall of the hive. The dead bees at the entrance should be drawn out, for which a bent wire may be used.

In the Plains bees do not require any greater protection in winter than a little quilting where necessary. They remain active and work regularly as in other seasons, the only difference is that the supply of pollen and nectar is limited in winter. Bees should be fed when the stored honey runs short.

Protection from Storm :—The hive should be kept securely tied to the stand with a piece of rope from being overturned by storms during the rains, and earlier in the season. A couple of bricks or any other weight placed on the lower structure of the stand will give additional security.

Water :—Bees require water all the year round, and more in the spring i.e. during the height of

breeding and honey flow season. Very rarely would they sit on the water-pots on which the hive-stand rests. They avoid these pots intuitively for fear of being drowned. Very often they resort to places which usually remain moist with water, clean or dirty. To help the bees in getting clean and fresh water, a clean piece of cloth soaked in water may be placed in a cup in front of the hives a few feet away, and fresh water added to it from time to time. The bees will sit on the wet cloth and suck the water. It is necessary that the cup containing the drinking water for the bees should be placed a little off from the track of their flight, for, they discharge excrements while on the wing. It is better to keep the vessel in a sheltered place.

Cleanliness :—The hives and the apiary should be kept clean. The water in the ant-preventing pots should be changed by pouring in fresh water daily or on alternate days, and the pots and dishes cleansed from time to time.

Commencing Bee-keeping :—By now we have acquainted ourselves with the 'Indian Bee'. We have gone through their life history. We now know the hive, the occupants and their mode of work. We have seen the artificial hive and the appliances, and know the general arrangements of the apiary. The work will now be commenced.

CHAPTER X

MAKING A START

Having provided ourselves with the best hives and appliances, let us proceed to get the bees and begin the work. The hive-stand should be placed in the position chosen, on water-plates filled with water, and the stand perfectly levelled from side to side, with about ½" slope towards the front, to drain off any possible rain water from the alighting board or moisture that may condense inside the hive. The place must be well lighted and well ventilated. It must also be easy of access for manipulation as has already been described.

A start may be made by purchasing from a bee-keeper, early in the spring, an *established colony* of bees on 10 frames for a Standard hive, or on 7 frames for a Newton hive full of grubs, eggs and honey, having a new laying queen. Such a colony if obtained in time and properly managed, and if everything goes on well, is sure to give surplus honey in the first season to the immense satisfaction of the beginner. If such a colony be not available then a *nucleus* having bees on four frames (two of which must contain grubs), a new laying queen and some honey in the cells for the bees, will do. If that also cannot be obtained then the only course left is to capture a *wild colony* from a natural abode. Colonies

established in decoy-hives tied to branches of trees or hung from the eaves, or kept in the recesses of walls, if available, will serve the purpose.

February, March and April are best for capturing wild colonies in the Plains, for, that is the good breeding season. The combs are then full of eggs, grubs and honey. The colony is then also fully populated. It is better not to disturb the wild colonies during the rainy season and the winter. In the Hills, March—April and then August—September will be suitable.

Capturing a Wild Colony :—After finding out a colony settled in the cavity of a wall or a tree-trunk or in an abandoned room or in any other place of shelter, the next work would be to transfer it to a modern hive. The process of transfer consists in cutting out the parallel combs with the bees on, tying the combs in the frames and placing them in the brood chamber one after the other, and removing the hive to the apiary in the evening after all the bees have been captured along with the queen. That is the process of capture described in a few words, but the beginner may not find the task so easy when he actually commences the work. Yet it may be said that for an experienced hand the operation is easy enough and the work is done by him smoothly, without fret or fear.

Now, select a bright day for the work, 9 A.M. will be good in the spring and early morning in other seasons. Equip yourself fully with the hive, complete with brood chamber and brood frames without wiring, the super without the frames, the bottom board

and the top. Assemble the other appliances e.g. the smoker with some rag or cocoanut-husk ; three swarm-catchers ; a penknife and an uncapping knife ; a pair of scissors ; and a few cut lengths of thin, dry and strong plantain fibres, each about 24″ long and ¼″ wide, cleansed with water and kept moist ; a feather ; a few sheets of newspaper ; a piece of cloth about one yard square and a tray. Get two friends to help you in the work.

Protect your hand and face with the gloves and the veil, then approach the wild colony and place the hive close by. Remove the top of the hive, the super and all the brood frames, keeping only the brood chamber on the bottom board. Keep the hive-door and the bottom board ventilator wide open. If necessary, widen the entrance of the wild abode so that the combs may be exposed to view and handled with ease. In widening the crevices of walls, bricks may be removed by cold-chisel and small crowbars ; for the cavities of tree trunks, carpenter's chisel may be used.

CUTTING OUT THE COMBS :—With great care get hold of the first comb which is in view, with the thumb, the forefinger and the middle-finger of the left hand, along with the adhering bees, without pressing the comb hard or crushing any bee under the finger-tips. (See 'The Sting' below). Blow some air on the comb where it is intended to be caught hold of, and the bees will move away from that particular spot. Cut out the comb along the line of attachment with the penknife or, if suitable, with the uncapping knife, after blowing off the bees from the track in the

manner just described. Proceed with the knife as you blow the bees off from the line of attachment, cutting out the comb completely. Remove the comb.

Take a frame, fasten the comb inside it with the moist plantain fibres. Pass a fibre round the comb and fix it up by drawing tight a knot on the upper side of the top bar, the upper edge of the comb touching the underside of the top bar. (See 'The Knot' below). Suspend the comb straight in the frame by tying it thus rigidly on to the top bar with the fibres, at three different places. Cut off the extra lengths of the fibres with the scissors. Now, place the comb in the brood chamber, cover the chamber with a piece of cloth or a sheet of newspaper, and keep it so covered till the next comb is brought in. Combs must not be kept exposed in the chamber at any time during the process of work. Cut out the other combs thus, one after the other, fix them in the frames and place them in the brood chamber. When all the combs have thus been transferred, place the super on the brood chamber and close down the hive by placing the roof over it. Care should be taken that the frames are placed with proper spacing. (See 'Spacing of Frames', page 83).

In drawing the fibre tight, see that the bees are not pressed between the comb and the fibre. The plantain fibre is used because this will keep the comb rigidly in position while the ordinary twine or any other string, if used, will cut the comb through. The combs should be cut to size to fit in the frames if they are large, but care must be taken that the

portions containing the brood and eggs are not trimmed off. The smaller combs may be left out when all the frames are full.

Dark, damaged, crooked, un-uniform and old combs without brood should be rejected. Combs having irregular upper edges should be cut straight by slicing off such portions, before they are fixed to the frames. The combs should hang in the hive with their tops up as they were in the wild abode and in the right way, i.e. two of the six sides of the cells should remain perpendicular.

The combs and the portions of the combs abandoned by the bees should be looked upon with suspicion and examined carefully, as there is every probability of these being infested with the caterpillars of wax moth, and should be rejected. Heavy combs, exclusively filled with honey, may not be fixed to the frames as it will be difficult to keep them suspended properly on account of their weight. Broken and unused pieces of combs should be kept covered in the tray with a piece of paper as the bees will be attracted if these are left exposed, and will be a source of annoyance.

As the combs are being cut and transferred to the hive, some of the bees in the cavity or in their original abode will be found receding from one comb to the other. Some of the bees in the brood chamber will also be coming back to the old place and join the receding bees. During the course of work bees will be flying about and hover round the head of the operator, but one need not be frightened by these.

And ultimately when all the combs had been removed, a small cluster may be found clinging at a corner.

If this cluster be in such a position that the bees can be moved on to the alighting board, then take the hive close to the cluster and with the feather move the bees on to the alighting board and guide them gently to the entrance. On finding the new home the bees will simply march into the hive through the entrance with the abdomen raised up, legs stretched and the wings slightly unfolded, indicating their joy in getting back their combs and grubs in their new abode.

If the bees could not be moved on to the alighting board due to any awkward position of the cluster, then place the hive close to the original abode with its entrance facing in such a way that the bees while attempting to get near the old abode, may approach the alighting board and enter the hive. Wait for a while. *If the queen had already been removed* along with the other bees while the combs were being transferred to the 'hive, then the small cluster will leave their place of shelter and enter the hive. Wait till the evening for all the foragers to come back from the field to enter the hive, then close the hive-entrance by pushing the door-slides, preparatory to the removal of the hive to the apiary. See that the bottom board ventilator is open. If the bottom board happens to be without a ventilator, then close the entrance with a piece of wire-netting having 14 or 16 lines to an inch. If that is not available then thrust a small quantity

of grass into the entrance in such a way that ventilation may not be affected, and at the same time the bees may not push their way out.

Carry the hive to the apiary when it is dark and place it on the stand kept ready to receive it. Open the hive-entrance as soon as the hive is placed in position and close down the bottom board ventilator. (For the details regarding the removal of the hive to the apiary, and keeping the frames firmly in the brood chamber, see 'Removing Hive after the Capture', page 145, and 'Keeping Frames in Position', page 146).

But *if the queen had not been so removed* along with the combs and had managed herself to be with the cluster, then the bees that were adhering to the combs in the hive will take wing as soon as they will find that the queen is missing and join her in the original abode or themselves form a cluster somewhere near the place and ultimately join the queen. In that case the hive must not be removed to the apiary, for, the queen has got to be captured and hived along with the bees.

CAPTURING THE CLUSTER :—Three courses are now open to secure the cluster :—

(1) to capture it with a swarm-catching net if it could be brought near the bees inside the cavity and manipulated without difficulty ; if not,

(2) to drive the bees out from the cavity by blowing a few puffs of smoke, and when they cluster again on the branch of a tree near-by or take shelter in any other place, to capture them with a swarm-catcher and bring the bees in that condition to the

apiary for hiving, and if convenient and thought advisable, to hive the bees at the site, or,

(3) to remove the frames from the brood chamber back to the cavity for the night and place them close to the bees so that they may slowly cover the combs again, when it will be easy to re-transfer the combs to the hive along with the queen and the bees adhering to the combs.

DRIVING OUT BEES FROM CAVITY :—In adopting the second method in order to drive the remaining bees from the cavity with the aid of smoke, light the smoker and blow just a few puffs when the bees will come out and cluster outside. But if the bees happen to be a long way off from the entrance, the small hand-smoker may not force the bees out. In that case wind some rags at the end of a sufficiently long split-bamboo, light it, then put out the fire and allow it to smother, or, sprinkle some water over it so that there might have enough smoke, and then apply the smoke by pushing the stick inside the cavity. Smoking must not be overdone as that will suffocate the bees. Withdraw the stick after a few seconds. Being unable to resist the smoke, the bees will be coming out and cluster outside. It will now be easy to capture them. When all the bees have come out, close the opening of the cavity with a piece of newspaper or cloth so that they may not re-enter it. Now, capture the cluster with the net. (For the details of manipulation see 'Swarm Catching Net', page 98, and 'Secure All Clusters' in this chapter, further below). In order to get a

compact mass of bees before they are secured with the swarm-catcher, *spray cold water* on the cluster with the aid of an ordinary *hand sprayer* (Fig 58). (These sprayers are commonly used for spraying disinfectants or insecticides in killing bugs, fleas etc.). Drench the bees thus with water thoroughly and this will make them come close together and press hard forming a solid mass, when it will be easy to capture them with the swarm-catcher.

Carefully remove the hive to the apiary with the combs in the brood chamber, as also the nets

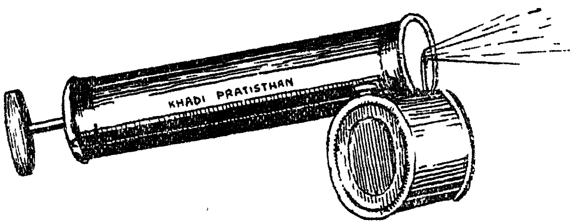


Fig. 58. Water Sprayer.

containing the bees if they are not hived at the site. Place the hive on the stand in its permanent position. (As to the removal of hive, see 'Removing Hive after the Capture' and in order to keep the frames rigidly in position in the hive, see 'Keeping Frames in Position', below). For hiving the bees from the nets, arrange as detailed below.

HIVING BEES FROM NET :—*Prepare a 'hiving board'* by placing one end of a piece of wooden board, about 18″ wide and 30″ long, on the ground and the other end flush with the alighting board of the hive, in a slanting position. Cover the board with a

piece of clean white cloth stretching upto the middle of the alighting board of the hive. Keep the hive-entrance open.

Now, remove the roof of the hive and place the loop of the net, containing the bees, on the super. Let one keep the loop rigidly in that position by pressing down the handle. Let another untie the knot of the twine (see pages 98-99) which kept the mouth of the net closed, and then raise up the two ends of the net and throw the bees down into the chamber by vigorously jerking it twice or thrice. Remove the net and cover the super with a sheet of newspaper or a piece of pasteboard. Wait for half a minute, and in the meantime throw the few bees that are still adhering to the net, on the hiving board, by turning the inside of the net out. Brush off the adhering bees with the feather. Now, take the next net, remove the newspaper sheet covering the super and jerk the bees down into the hive as before. When all the nets have thus been emptied one after the other, close the hive by placing the roof carefully, so that bees may not be crushed. (The method of placing the roof in position without crushing any bee has been described below.)

As soon as one net has been emptied in the manner described above, some of the bees will 'boil up' and some will take wing. But the bees will calm down to a great extent as soon as the super will be covered with a sheet of paper or pasteboard. To wait for half a minute, as stated above, after the first net has been emptied, is to give the bees a little time to

settle down before they are put to commotion once again by the second lot of bees that will be shaken in.

The *roof can be placed in position* by placing first its off-side left corner on the corresponding corner of the super, and then placing the other corner by slowly moving the right side up and down, so that the bees that may happen to be adhering to the upper part of the wall of the super may move away by the gentle pressure of that movement. The side of the roof just in front of the operator, should also be placed in its position in the same up and down movement.

While emptying the nets, take that one first which contains the queen if she was not in the hive already, or take that net which is the heaviest of all. Of the nets containing the bees, one containing the queen will be found to be comparatively calm. A few bees may also be seen adhering to that net on the outer side.

The bees on the 'hiving board' will creep up and enter the hive through the door. Guide them a little with a feather. While emptying the nets, the two operators must stand on the two sides of the hive; one of them may stand at the back if necessary, but never in the front. Some of the bees may take wing and settle in clusters near the front and back ventilators of the roof and underneath the bottom board. These may be brushed on to a pasteboard and pushed with a feather on to the alighting board near the entrance. Leave those bees alone for the night that may still be clinging here and there, for they are sure to enter the hive next day when better

sense will prevail. Remove the hiving board as soon as hiving is over.

Evening is the most suitable time for hiving swarms captured in the nets during the winter. If the swarm is netted during the earlier part of the day, the bees will keep well in the net if they are to so remain till the evening to be hived. The nets with the bees may be kept suspended in a cool room, made half dark by closing the doors and windows so that the bees may not get direct light and glare as that will excite them to make themselves free and create a great uproar. Proper ventilation of air in the room should be looked into. Care must also be taken that ants do not approach the nets.

If the room becomes hot, spray some cold water in the air inside the room and on the floor from time to time, with the sprayer, and thus keep the room cool till the bees are hived. Spray some water also on the nets if the bees inside seem to be hot and restless, and make a sharp buzzing sound or a cracking noise. On being sprayed with cold water they will at once calm down.

It is better to hive swarms earlier in the day during the hot weather because the bees may get exhausted if they are kept huddled together in the net for several hours. They may even lie at the bottom of the net motionless, in a semi-conscious state in spite of spraying water, due to heat and partial suffocation. If the bees are found in such a bad plight, one must not give up hope, for, soon after hiving they will recover themselves on getting fresh air, and slowly

creep up the walls of the hive and spread over the combs. Therefore if, in any event, the bees are found to drop down like a dead lump while emptying the nets, the beginner need not get frightened, as gradually they will show signs of life, spread themselves over the combs as already stated, and search for both the brood and food. And in the next morning, only a few may be found lying dead on the bottom board.

WHEN FRAMES ARE REMOVED BACK TO CAVITY :—If the third alternative is adopted, (page 132), that is when there is a cluster in the cavity and which could not, for any reason, be captured or smoked out, and when the combs as tied to frames are removed from the brood chamber and placed inside the cavity, then, the frames should be kept there for the night, placed at right angles to the entrance, and as close as possible to the cluster. Early in the next morning approach the place and inspect the combs. The bees may now be found to have covered the combs. Remove the combs now to the hive. By careful manipulation of combs, while they are being transferred to the hive, the queen could be seen moving about in one of them. But one need not be anxious to search her out. Remove the hive to the apiary immediately after the frames are placed inside the brood chamber and the top is closed by placing the roof in position. See that the hive-entrance is closed and the bottom-board ventilator opened.

Before the removal of the hive to the apiary, the cavity should be examined, and any cluster found there should be captured in the swarm-catcher and

brought to the apiary. These may be hived from the net by dumping them on a hiving-board arranged as soon as the hive is placed on the stand and the door is opened, and the bottom board ventilator closed.

But contrary to the expectation, if in the next morning most of the bees are found clustering at a corner, then after transferring the combs to the hive, the bees should be smoked out, captured in the nets and hived in the manner already described.

Secure All the Clusters:—If at any time of the clustering of the bees outside, it is found that they have divided themselves into more than one cluster, then wait till they unite and form one single mass. And, if the cluster be not compact, i.e. if the bees hang loosely, spray some cold water on the bees with a sprayer, and they will at once close up and make a compact mass easy to be secured (Fig. 59). If, on waiting for a reasonable time, it is found that the clusters do not unite, then secure all the clusters in separate nets so that the queen may not be missed.

Fig. 59. Swarm Captured in a Swarm-catcher.

Decoy Hives:—Decoy-hives tied to trees, or suspended from eaves, containing live bees, should be brought down by closing the entrance with a piece of cloth, and placed on the ground. On account of the very nature of the hive, it may not be possible to cut out the combs with the bees on. In that case, a very vigorous thumping on the sides of the hive will force the bees to recede, leaving the combs bare. Combs may then be cut out one by one, fixed on to the frames and placed in the brood chamber. Bees may then be hived by shaking them off to the hiving-board or in the way found convenient and suitable to the circumstances in which the bee-keeper finds himself to be placed.

Another method is to apply two or three puffs of smoke at the entrance of the hive, after it has been brought down to the ground from the place where it was kept tied. The smoke will make the bees leave the combs and recede to one end. The combs may then be cut out, fixed to frames and housed in the brood chamber. The bees may then be hived by shaking them directly into the brood chamber, or by holding the decoy-hive over the brood chamber, upside down, and then passing a feather slowly under the bees from one side to the other close to the place where they are clinging. They will thus be dislodged and drop down in a lump over the frames. Whenever the bees are hived through the open top of the hive, the super should always be kept in its place on the brood chamber.

When an earthen pot is to be tackled as a decoy-hive in order to transfer the colony, the pot has got to be broken open in order to get at the combs if its mouth be not sufficiently wide. But before it is broken open, the bees must first be made to recede by thumping or by the application of a little smoke.

Bees may also be hived from the decoy-hives, after the combs have been cut out, by shaking them off to the hiving-board, as has already been stated, kept in position for the purpose. They should be guided with a feather and moved up to the entrance. In this case, the roof should be put on and the door kept wide open before the bees are hived. The bees and the combs should be protected from the direct rays of the sun while handling them in hiving a colony.

Beginners are warned against over-smoking while attempting to make the bees recede from the combs. For, it might so frighten the bees and they may be so shocked that they may swarm out. In such a contingency, the first thing would be to capture the swarm in the swarm-catching net as soon as they settle, forming a cluster. But we would like to impress that one should try to avoid smoking the bees, as far as possible, while transferring a colony from the decoy-hive to the frame-hive. Another note of warning has already been given about over-smoking from the stand-point of suffocation.

The methods of hiving wild colonies have thus been described in detail. By studying the position of the wild colony and by a slight alteration of methods

to suit the condition as presented at the time of the capture, the colonies can be transferred successfully into frame-hives, in whatever position they may happen to be. We successfully work on these methods and find them easiest and surest.

Other Methods :—For capturing the wild colonies, some bee-keepers prefer to smoke the bees plentifully after opening wide the entrance, so that the bees may be forced to leave the combs. Combs are then cut out, fixed into frames, and the receding cluster of bees is scooped up with a cup in several lots or removed in handfuls into the hive. Profuse smoking is attended with the danger of so frightening the bees that when captured and hived they may desert on the next day of capture or within a few days.

One should be very careful in scooping out the bees. Any injury to the queen will make her useless. An injured queen may lose fertility and stop laying eggs, or her laying capacity may be so decreased that she will be useless for all practical purposes.

Capturing the queen from the cluster by gently lifting her off and keeping her as a captive in a match box with its inner case slightly open for ventilation, or in a test tube closed with a piece of cloth or mosquito net, is also another method. If the queen can once be captured, the trouble of securing the bees will be avoided. The imprisoned queen is to be placed in the hive on the top bars so that the bees in search of the queen may find her and ultimately rush in and occupy the hive. The queen may then be released on the top bar and the hive closed.

Confining the queen thus is good when such capture and removal from a cluster is possible and done neatly. But the possibility of finding the queen from a cluster by a beginner, or actually spotting her when she is hurriedly moving about in the cluster, may be remote and there is also the risk of mishandling the queen.

Swarm on Trees :—If the bees swarm out and settle on the branch of a tree at a low height, the cluster could be approached by climbing the tree with the swarm-catchers in hand and an assistant behind. But if the branch is high enough and the approach be risky then the bees should have to be handled from the ground.

Fasten the handle of the swarm-catcher horizontally on to a bamboo pole sufficiently long, and after netting the bees by manipulating the pole from the ground, lower it down quickly and close up the mouth. We have in this way very successfully secured bees that had settled high up on weak branches not able to bear the full weight of a man.

If the bees cluster on a low branch and the position is such that the swarm-catcher can not be manipulated on account of the inter-twining of branches or on account of thorns, then hold the swarm-catcher underneath the cluster as close as possible and let one strike a sharp blow on the branch with a thick stick, close to the cluster, when the bees will be dislodged and will drop into the net. If it is not possible to strike a blow on the branch from which the cluster hangs, then give the branch a

quick and a vigorous shake and the cluster will fall into the net below.

If the cluster is very compact and the branch is such that it could be cut out without the least disturbance to the bees, then cut the branch off with a pair of pruning-shears or a hand-saw or any other suitable appliance, and hive the bees by jerking them directly into the brood chamber.

The Sting :—One must be prepared to get stings while capturing a wild colony. Bees will rush out of the hollow as soon as an attempt will be made to widen the mouth with a chisel or a crow-bar. They will first try to frighten away the intruder by trying to sit on his face, and baffled by the veil, they will hover round the head. But the work must have to be continued without minding the bees.

If the combs are cut out and removed without jarring and roughly handling the bees and without causing much irritation, one may escape with no sting or with less than half a dozen stings. In order to cut out a comb with the bees on it, gently place the fingers on the comb, and the bees underneath the fingers will move away at the slightest touch of the approaching fingers. The comb can then be caught in a close grip.

Some bee-keepers advocate the use of bare hands for the beginners instead of using gloves, and thus endure the stings. For, it is contended that with the gloves on, one cannot properly handle the bees and a number of them may be crushed in the process of removing the combs. But the use of gloves by

the beginners should be considered as a matter of convenience in the earlier stages only, and nothing else. As to enduring the stings let the readers know that the author tried to please all his advisers by not using either the veil or the gloves at the very beginning when he first started capturing wild colonies in 1936, and came to grief several times in several ways and ultimately had to use both. Gloves were discarded as soon as confidence had been gained and the art in handling with bare hands learnt. (See page 89, for 'Bee Veil and Gloves', and Chapter - 38 for 'Use of Veil in Bee-keeping').

Even if we leave aside the stings received while capturing a wild colony, the bee-keeper in spite of all the precautions taken, is sure to be stung occasionally during his usual course of work in the apiary. But the sting must not be considered as a serious hindrance or drawback to bee-keeping. Dipping the hands in clean water before handling the combs is an easy way of avoiding stings to a great extent. This the author does invariably, for which a mug of water is always kept ready at hand while examining the colonies.

But then, the sting should be considered from another stand-point quite different from the pain that it causes, and that is the curative value of the bee-venom. It is said that bee-venom cures ailments like rheumatism, for which live bees are applied to the afflicted parts and they are made to thrust their stings. As opposed to natural stings, the bee-venom is now-a-days artificially injected also. But in order

to test thoroughly the remedial value of bee-venom, it would be best for a physician-beekeeper-patient to try the stings on his own body and study the reaction both from the view-point of cure and research work. In this case, a physician-patient has got to be a bee-keeper for all practical purposes.

Removing Hive after the Capture :—The hive should be removed to the apiary very carefully after capturing the colony (Fig. 60). It should be securely tied with a piece of rope round the roof and bottom board. It may be carried on one's head, being placed on a piece of board, or on the shoulder, without tilting this side or that, and without any jerk so that the spacing between the frames may not be disturbed and the bees may not be pressed between the combs. (See, 'Keeping Frames in Position', below).

Fig. 60. Coming back with the captured colony. Bees are in three swarm-catching nets.

By the careless handling of the hive, there is also the risk of the combs being dislodged on account of their weight. One should walk slowly with the precious load now inside the hive, secured after a day's hard and eventful labour.

Keeping Frames in Position:—When the hive is being carried on one's head, the frames may be kept in position by adopting the following simple

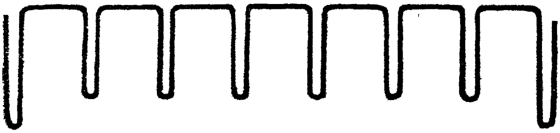


Fig. 61. Wire Frame-Scaper.

device of wire 'Frame-spacer', if self-spacing frames are not used. Fold a piece of stiff wire in a series of 'U' s, $\frac{1}{4}''$ wide and one inch deep, separated by straight runs of $\frac{7}{8}''$ each to take the frames in. There should be as many straight runs as the hive can take frames. If the brood chamber can hold 7 frames then there should be 7 straight runs. Fold the ends of the wire up, very near to the line of the straight runs (Fig. 61). Insert two such 'frame-spacers' over the shoulders of the frames in the brood chamber, at the two ends of the frames, and press them down.

The $\frac{7}{8}''$ straight runs will fall flat on the top bars of the frames and the $\frac{1}{4}''$ width of the figure of 'U' will keep the proper space between the frames. The arms of 'U' will go down deep into the chamber, between the frames, to the extent of one inch and by pressing against the side bars of the frames will keep them

rigidly in their own place. The two ends of the wire by pressing themselves on the two walls of the chamber will work like a spring and keep their own place also.

Ventilation :—Cases are known when after the capture of a wild colony, beginners, due to oversight or ignorance, removed the hive to the apiary in the evening, securely closing the hive-door, without making any provision for ventilation with the idea that the ventilators in the two gables on the top will serve the purpose, and thereby keeping the hive in that condition overnight. On opening the hive-door in the morning when neither the bees came out nor any sound was heard, the removal of the roof revealed a dismal appearance. The bees were all found suffocated to death and strewn over the bottom board, some clinging on to the combs, dead. It must be remembered that fresh air is equally necessary for the bees and care must have to be taken for proper ventilation.

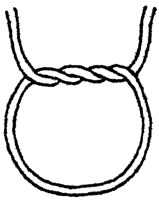


Fig. 62.
Double twist of the first half-knot

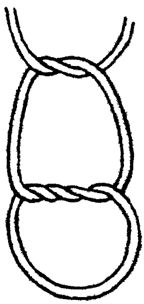


Fig. 63.
Knot completed by a second knot over the first half-knot.

The Knot :—When tying the combs in the frames with plantain fibres, instead of tying a 'Reef Knot' which is made by two simple knots tied one over the other, tie with the 'Surgeon's Knot', which is made by first forming

a bight and then passing one end of the fibre twice round the loop and then pulling the ends tight (Fig. 62). Complete the knot by tying a simple knot over it (Fig. 63). It will have a firm grip and will not slip. The double twist prevents the slipping of the first half-knot, which otherwise is apt to take place while tying the second.

Rejected Combs :—From the lot of the rejected combs, portions which are straight and have uniform cells, fresh and free from the attack of the caterpillars, may be sunned and kept in screw-capped wide-mouth bottles or in tin cans with tight-fitting lids. These may be used as comb-guides when required and the rest should be melted into wax. (See 'Extraction of Wax' in Chapter-43). Combs set apart for melting should be pressed hard into lumps and kept in tin pots or boxes with their lids closed, till they are taken out for melting. Combs or bits of combs should not be kept exposed or thrown away near the hive or kept carelessly anywhere in the apiary as these will then attract the wax moth.

Failures in Capture and in Keeping Bees :— A beginner may get disappointed by some of his new captures absconding. Bees sometimes abscond on account of injudicious smoking and defective handling of bee-clusters in hiving them, and for want of food.

Care of the newly-captured colonies is also a factor which must be taken into account. (See 'Care of Newly-Captured Colonies', Chapter-11). After the removal of the hive to the apiary, bees require close attention till they come to their normal state.

The behaviour of the bees should have to be closely observed from the next morning after the capture, and this observation and prompt action in remedying the defects noticed, will save many a colony from decamping.

Starting bee-keeping by simply reading a pamphlet or a booklet is bad. One must not do this. The beginner is advised to read a good book on bee-keeping thoroughly, not once or twice but several times, till he becomes conversant with the subject, and then begin work. Lessons from a practical bee-keeper will be very helpful to the beginner.

If he fails to succeed at the first attempt, there is nothing to be ashamed of. Failures are the pillars of success, and in bee-keeping it is cent per cent true. Try to find out the reasons of failure and solve the difficulty. Consult the book at every step. Seek advice from a practical bee-keeper who may be in the neighbourhood or from one with whom you are acquainted. Bee-keeping may seem to be difficult at the beginning, but once the art is learnt by experience and practice, the whole thing becomes easy, pleasant, attractive and its fascination and romance will absorb one deeply into it.

CHAPTER XI

CARE OF NEWLY-CAPTURED COLONIES

On the morning after the capture, observe the movement of the bees. You will find them in hurry and bustle. They will circle round the hive and reconnoitre the place. If everything be in order, the bees will engage themselves in the work of the hive. They will clean the combs and the bottom board, remove the bits of broken combs, dead bees and grubs. Some will sit on the alighting board near the entrance and fan in fresh air by the flapping of their wings. Some will begin foraging, while others will settle down for the work inside the hive.

Listen to the Hum of the Bees Inside :—Having observed the movements of the bees on the alighting board and round the hive, listen to the hum of the bees inside the hive by placing your ear on the side-wall of the brood chamber. This examination of the hum from outside will give you an idea as to how the bees are working inside. If the hive does not contain all the combs that it can hold, then place the ear on that wall of the brood chamber from which the combs are arranged. Next, place your ear also on the roof and get the sound. A sharp or a dull simmering sound, or a combination

of a harmonious succession of *smooth and continuous sounds agreeable to the ear,* will indicate that the bees have settled down to normal work.

But if there is a discordant note, an uproarious noise, a harsh cracking *sound jarring to the ear,* then it must be understood that the bees are in a fix, moving about in excitement and have not decided whether they should stay in the new abode or decamp.

If *no sound is got* from the side-wall of the brood chamber, and just a faint or no sound from the roof, then it is evident that the bees are not in a mood to settle down, have abandoned the combs and sent 'scout bees' to find out a suitable shelter, and in the meantime have kept silence. (See 'Scout Bees' in Chapter - 22). But if *at the top the sound is distinct and voluminous* then it must be understood that the bees have clustered on the roof and have partially or completely abandoned the combs.

The movement and the conduct of the bees on the alighting board and the sound inside the hive will at once bring home to the bee-keeper how and what the bees are doing inside. A beginner must have to train his eyes and ears both. *If the bees are listless* and seem to be weary and indolent, if they hurry about the alighting board, if they come out in numbers and settle outside near the front or back ventilator in the roof, underneath the bottom board, on the sides or in any corner of the hive, then view these abnormal movements with suspicion. It may be that the bees have no desire to own the new abode or that the queen

is lost. This state may even continue for two or three days. The beginner need not be alarmed at this, for the remedies are in his hands—sure and positive. The first approach to the bees should be through their stomach for which artificial feeding is necessary, the details of which will be found below. But the colony requires a thorough examination first.

Open the Hive :—The examination of the hum of the bees from outside being over, proceed to examine the bees and the combs. Open the hive between 8 and 9 in the morning. But before the hive is opened, get all the necessary things that may be required during the work, ready at hand. These are a penknife, a feather, one or two pasteboards large enough to cover the brood chamber, one empty brood chamber, a mug of water, dilute ammonia in a phial, a pair of scissors, a foot-rule or a piece of split-bamboo stick of that size (this is to pick up small bits of combs from the bottom board), and a hive-tool.

A small table having a top of about 24″×18″, and about 24″ high, will be very helpful while examining the colonies. The extra brood chamber should be placed on it as also the other implements, and carried from one hive to another as the examination will be going on. If a comb has got to be removed from a hive and kept outside, the extra brood chamber placed on the table and kept beside the hive would serve well, because the bees will get a shelter closed on the four sides when the comb will be placed in it and feel themselves very comfortable, though the period of examination and manipulation may be short.

If there are ants near about, then place the legs of the table in cups full of water. This precuation is well worth taking.

In opening the hive, slightly raise one side of the roof and peep in, have a look on the frames, look for the bees at the top, and then remove the roof. If there is any cluster on the top then place the roof carefully on a separate empty brood-chamber, with the cluster hanging down and without disturbing the bees. But if the hive-top is free from cluster, the roof can be placed directly on the table, upside down. Do not crush any clinging bee. Remove the super. Remove the two wire frame-spacers from the brood chamber, if used.

If the Bees have Settled Down :—If the bees are found to have settled down and started work and if there are frames, more than one, not covered by the bees, then of the uncovered combs take one and place it between the combs covered by the bees and remove the remaining uncovered combs from the hive. In other words, keep as many combs in the hive as the bees can cover fully, except one uncovered comb which is to be interposed as stated above. This provision of one uncovered comb is made because it will be found on examination that the bees have settled thickly on the combs beside the wall, and one empty comb when interposed will relieve this congestion. If any grub comb is left unattended then that comb should be interposed instead of one empty. Combs that have sagged or broken down during the removal of the hive from the place of capture on account of jerking, should

be properly tied to the frames anew. Bits of broken combs should be removed from the bottom board.

The queen may be seen moving about during the course of manipulation. (See 'Manipulating the Frame', in Chapter - 13). The examination being over, the frames should be closed up, the space adjusted, and a dummy board placed beside the last comb. with proper spacing. The colony should be fed.

Feed the Bees :—Feed the bees with thin syrup made from white cane-sugar crystals. (See 'Preparing Syrup', and 'Precaution in Feeding', in Chapter - 12). Fill the feeding bottle with syrup, tie up a piece of cloth over its mouth, (see page 93). Drive the bees down into the brood chamber from the top bars and place the feeding bottle quickly, upside down, on the frames just in the middle, and close the hive. The bees should be fed in the evening and the bottle removed in the next morning. If in placing the bottle any bee unexpectedly gets pressed between the mouth of the bottle and the frame, then do not try to free her for it would not be possible to place the bottle back just then once it is removed, as by that time the bees would become very furious.

The bees should be fed in the very evening the wild colony is captured, after the hive is placed on its stand and the bees are shaken in from the swarm-catchers. For, this feed would make them settle down to the work of the colony and keep them in proper mood. Feed the bees twice or thrice during the first week. The bottle should be kept half full while feeding.

In removing the feeder, take it slowly out, close the hive and by a single vigorous jerk, throw off the bees that may still be adhering to the mouth of the bottle, in front of the hive. Directly the bees will come back to the alighting board and enter the hive. The empty bottle and the piece of cloth should be washed, dried in the sun and kept ready for use for the next time. It is better to moisten the piece of cloth first, and then tie it to the mouth of the bottle in making the latter ready for feeding.

If the Bees have Clustered :—If the bees are found to have clustered on the top inside the hive, then examine the frames, tie the combs again if necessary, and close them up *without the dummy board*. Place the super in position and place a feeding bottle with syrup on the top bars of the frames as detailed already. Arrange a hiving board.

Hold the roof above the super and dislodge the bees on the frames into the brood chamber, with a feather. Shake off the few bees that may still be adhering to the top, on the hiving board, and close the hive. The frames may be closed up with the dummy next morning when the bees have settled down to work. The bees clustered in any corner of the hive outside may be brushed on to a pasteboard and thrown on the hiving board. If the bees have clustered in any corner inside the brood chamber off from the frames, then the frames should be placed on that side slightly pressing the bees, so that they may be forced to creep up the combs, or, the bees may be removed with the feather and placed on the top bars of the frames.

If in any case the grubs in the combs are found dead on account of the bees having abandoned the combs and clustered somewhere else in the hive—in a very rare case this may happen in April due to excessive heat—and that a foul smell is emanating, then remove all such grub combs and keep only those that contain honey and pollen and otherwise passable. Get at least one brood comb having eggs and grubs in different stages from another colony that one may have in the apiary, shake off the adhering bees from it and insert it in the hive in question and then hive the bees as detailed. (For removing bees from a comb, see 'Removing the Bees', in Chapter-13). If such a comb be not available then of course the bees have got to be hived without it. In adopting this procedure one must be thoroughly satisfied that the grubs in the combs were dead.

If after hiving the bees in the manner described above, it is found on the next day that the bees have again abandoned the combs and crawled up to the top, then in order to prevent the bees from crawling up, a quilt may be placed over the frames and the bees hived through the entrance by shaking them on a hiving board. (For 'Quilting' see page 121). The bees should be shaken off a foot away from the entrance and guided gently towards the door with a feather. Before placing the quilt over the frames, cut out a round piece from the centre of the quilt slightly larger in diameter than the mouth of the feeding bottle. Place the feeder over the frames through the opening thus made

in the quilt. Cover the hive with a piece of pasteboard and then dislodge the bees from the roof on the hiving board ; clear the roof of the few bees that may be still adhering and then close the hive with it. In the case of a swarm thus being hived, the hive-top must be kept closed with its roof on. The quilt should be removed as soon as the bees have settled down. (As regards feeding, see 'Feeding the Bees', Chapter - 12 ; also see 'Preparing Syrup' in the same Chapter. As to the handling of bees see 'Handling the Bees', Chapter - 13).

Work Inside the Hive :—Bringing pollen by the bees, in a newly-captured colony, may be taken as a sure sign that they have settled down and accepted the new home. Bees, if settled, will be collecting pollen from the very morning after the capture or from the forenoon. In about three days the bees will fasten the combs to the top bars.

The hive should be next opened on the fourth day and examined. It will be found that the bees have very nearly finished cutting the plantain fibres. The bottom board will be found unclean, strewn with small chippings of fibres and bits of broken combs. Examine the combs one by one. If it is found that a comb has been thoroughly fastened to the top bar, then cut out the fibre with the scissors and remove it carefully by drawing the ends of the fibre downwards. Place the comb in the hive, then take the next one and go on inspecting and removing the remnants of the fibres. Do not cut the fibre of that comb which has not been properly fastened.

In this connection let us add here that we tried ordinary plain tape, less than half an inch in width, in fastening the combs to the frames in the place of plantain fibre, but we found that the tape covers a lot of space of the comb and thereby shuts off a great number of grubs in the cells. And then, it puts the bees to unnecessary strain in their attempt to cut it off, the tape being very strong.

Cleaning the Bottom Board :—In order to clean the bottom board, raise the brood chamber with the frames on, remove the bottom board and place any other board on the stand and then place the brood chamber on it. See that no bees are crushed in doing so.

Scrape out any wax that may be adhering to the bottom board and wash it with running water. Dry it in the sun, and then place the hive again on its own bottom board. Any dirt that may be adhering to the lower end of the brood chamber should be wiped off with a piece of cloth.

Instead of cleaning the bottom board thus, the best course would be to change the hive, for which remove the hive to a separate stand placed at the back, put another hive on the original stand and then transfer the combs to it one after the other, placing them in the same order as they were before. Shake off the bees that may be adhering to the walls of the brood chamber, on the ground in front of the hive.

The Queen :—While examining the combs as stated above, try to find out the queen. She must be found in one of the combs. (See, 'Searching the Queen', in Chapter-13). In the act of cutting

out and removing the plantain fibres, see that the queen is not disturbed in any way. If the queen could not be searched out then examine the cells. If eggs are seen then one may be sure that the queen is somewhere in the colony and she is laying. And if there are no eggs, and the queen is taken to be lost, then the colony should be re-queened, for which see 'Re-queening the Colony', below.

Do not starve the Bees :—If during the examination it is found that there is no sealed honey or honey in the open cells then the bees have got to be fed. (See 'To Prevent Shortage of Food and Starvation', and 'Precaution in Feeding' in Chapter-12). If the season is such that sufficient nectar cannot be obtained, then continue feeding from time to time till the bees begin to store nectar enough for their own requirements. Cases are known when bees are found to have absconded even after two months, though they seemed to have settled down, bringing pollen, and the queen was laying eggs, only because the colony was starving and on examination not a drop of honey was found in any of the cells.

It would be wrong to think that the bees become idle if they are fed artificially. Feeding is a necessity when food runs short. On the other hand, starvation compels them to abandon the hive and search out a better place and a better bee-keeper. The timely supply of artificial food would save many a colony from absconding. Negligence and the habit of putting off things for the next day are responsible for the loss of not a small number of colonies.

Enlarging the Brood Nest: Addition of Frames :— The colony should be built up to full strength by the gradual addition of wired frames with comb-guides or frames fitted with full sheets of worker-base foundation, so that the bees may gradually build combs. Fresh frames should be added one at a time and placed in the centre of the nest between the grub combs. When the frames that are already occupying the brood chamber are fully built and are well covered by the bees then only should a new frame be inserted.

If in the meantime brace combs are built then that would indicate that the bees are anxious to build combs, and in the absence of fresh frames or being unwilling to cover fully the existing frames on account of the combs in them being old, dark in colour, brittle or otherwise unfit for further expansion, they have built those brace combs. In that case, instead of waiting for the existing combs to be fully built up, they should be given new frames with guides or foundation sheets. The brace combs should be removed. As has been stated before, they serve well as comb-guides.

One thing requires to be stated here. Whenever a fresh frame is inserted, whether with comb-guide or comb foundation, the colony must be examined a week after, i.e. on the 8th day after such insertion, for there is every probability of queen cells being produced. This is because by the insertion of a frame in the middle of the colony, the brood nest is divided, some of the grub combs remaining in one side of the

new frame and some going to the other. And naturally the queen is thus confined to one set of combs only, either in this side or that. And the queen may not go over to the other side so separated by the new frame. In that case the bees of that side considering themselves motherles, would invariably start queen cells. To avoid such complications one should make it a point to examine the colony on the 8th day after the insertion of a new frame, and cut off all queen cells if produced, of course, after ascertaining the presence of the reigning queen first.

Re-queening the Colony :—But early in the week, if during the examination of the combs it is found that there are no eggs in the cells and that the queen is also missing, then see if there are queen cells round the edges of the combs either on the side or on the bottom, and on the face of the combs. And further see if there are grubs in these queen cells. The presence of queen cells is the sure sign that the reigning queen is lost. This may be due to mishandling while capturing the colony or due to careless and awkward manipulation of frames thereby crushing the queen.

When queen cells are found within a week of the last examination of the colony, then remove those cells that are sealed and mature, for these are from old grubs ; blow off the bees from those cells and cut them out with a penknife ; keep only those cells that are open and about to be sealed. (For further details regarding the removal of queen cells that are not wanted, see 'Removing Queen Cells', in Chapter - 14).

Four days after, examine the queen cells again. Of the sealed cells, keep only two which are well shaped, well placed, look healthy, and are of different ages, i. e. one is more ripe than the other, and remove the rest. (See 'Ripe Queen Cells', in Chapter-24). Queen will emerge first from that cell which is more ripe and kill the other queen which is yet to emerge. Two cells are kept because if one happens to contain a dead pupa, queen may emerge from the other. (Also see 'Raising Queens', in Chapter-24). In due course the virgin will be impregnated and begin to lay eggs.

If there are no queen cells and one is sure that the queen is lost, or if queen cells are there but they are empty, i. e. do not contain grubs, then in order to re-queen the colony take out a grub comb containing eggs or larvæ just hatched, from another colony if the apiary happens to have any, jerk the bees off and give it to the queenless one. (See 'Removing the Bees', in Chapter-13). Queen cells will be produced by the bees in this comb.

To induce the bees to produce queen cells and to give them a stimulus for the work, choose a worker cell containing an egg preferably at the bottom or at the side of the comb, enlarge the cell by breaking down its walls as also the walls of the other cells immediately surrounding it with the aid of a long sharp-pointed needle, without disturbing the egg. Choose more of such cells containing eggs as also some containing young grubs below three days old, and enlarge the cells. The bees will at once sit down to

mend them and in the process will draw out queen cells round these eggs and grubs, increase the size of the cells and lengthen them as they will be going on feeding the grubs within. If left to themselves they will, of course, choose cells as are found suitable to them and produce queen cells, not one but many, as a provision against emergency, though ultimately they will allow only one queen in the hive to reign over them.

Instead of removing one entire grub comb from a colony for queen-rearing, a portion of a comb containing eggs and young grubs may be cut out and tied or fixed with pins to a comb of the queenless colony in a similar position and angle in which it was in the original comb. The position chosen for fixing it, should be cut to size and trimmed to receive the cut-piece of the comb containing eggs and grubs. The bees will soon fasten the piece and start queen cells.

Grafting Queen Cells :—In order to re-queen the colony it would be best to graft a sealed queen cell if available from any other colony. To cut out a queen cell for grafting, gently blow off the bees from that portion of the comb and cut out a small patch of comb with the queen cell in the middle or at the side, without pressing or in any way injuring the cell. Cells in a pair, or cells unsealed may also be cut out. The piece of comb with the cell should now be fixed to a comb of the queenless colony with one-inch long pins driven through the portions of the comb, round the cell. When there are sealed cells in a pair, one of them may be destroyed by piercing it with a long

sharp needle at two or three different places, thereby destroying the pupa within, or by cutting out the tip of the cell with scissors very carefully, and then drawing the pupa out, leaving only the other cell intact. This is to avoid two queens emerging at a time.

Queen cell built on the face of a comb may be cut out by pushing a sharp penknife right through the comb round the cell and taken out along with a portion of the comb about $1\frac{1}{2}''$ square with the queen cell in the middle, and grafted. Bees will at once sit round the grafted queen cell and tend it. Much valuable time can be saved in rearing a queen if the bees get a mature cell ready. (See 'Introducing Queen Cells', in Chapter-24).

Loss of Colony :—When there is no second colony in the apiary from which a grub comb can be availed of or none can be procured from a neighbouring apiary, then it should be noted with regret that this queenless colony cannot be saved. It is sure to perish.

The loss of a colony in such a case is unavoidable. But armed with the experience acquired by this first capture, though unfortunately it ended in a failure, and now being conversant to a great extent with the nature and the habits of the bees by practical work, possessing knowledge gained by close and intelligent study of the bee-book, the beginner would be well advised to look for and capture a second colony to meet with better results, when in this attempt success may be assured. (About reading books, see

Chapter-26). It is advisable to start with at least two colonies so that in case of emergency one may come to the help of the other and the work may continue uninterrupted.

Fertilisation of the virgin queen reared in a queenless colony as described above, presupposes the presence of drones flying to inseminate the virgin. But if there be no drones then the queen cannot mate and in that case also the colony is doomed. If there are established colonies in the apiary but the season is such that there are no drones or no flying drones, then the only course to save the bees of the queenless colony and to avoid the possibility of 'laying-workers' laying drone eggs, is to unite it with a queen-right one. (As to the method of uniting, see 'Uniting Stocks', Chapter-21).

CHAPTER XII

FEEDING THE BEES

Apart from the consideration of saving the bees of a newly-captured colony or a swarm from starvation, and apart from the stand-point of an artifice in inducing the bees to take the new abode as their own and adopt it as referred to in Chapter XI, artificial feeding becomes necessary for other reasons also, e.g. (1) to stimulate the queen to continue to lay eggs, (2) to set the bees to build combs for the expansion of the brood nest, and (3) to keep up the bees when there is not enough nectar in the fields for collection, and when the stored honey—their natural food—runs short.

(1) **Feeding : A Stimulus to the Queen** :—A careful observation will show that the queen restricts her egg laying when the stored food in the combs becomes insufficient and when the population is such that it cannot fully cover the grub combs. Her instinct in birth control is wonderful. May be, she does not like to give birth to many a hungry mouth without being sure of the provision, and does not like to see the untimely death of grubs in the breeding cells if the bees cannot maintain proper warmth and bestow the most tender care to rear them up, on account of the insufficiency of population. While waiting for

better days when the nectar will be flowing profusely, she will try to make good the dwindling population by laying only as many eggs as could be properly attended to by the bees.

The workers also do not like to rear brood in quantities unless sufficient nectar is forthcoming, for it is observed that when an erring mother lays eggs in excess of that which cannot be properly attended to, the workers remove these eggs and keep the cells empty. But at a time when the brood nest has got to be increased, artificial feeding is necessary as a stimulus to the queen so that she may increase the area of her activity and lay more eggs, and that rapidly too. The bees then should be fed slowly and the feeding continued, once or twice a week, till the colony comes to full strength.

(2) **Feeding for Comb-building and Raising the Population** :—In order to enlarge the size of the colony, frames having comb-guides or foundation sheets shall have to be inserted from time to time. Bees consume food to build the comb. And for the secretion of a pound of wax, bees consume about 10 lbs. of honey. Therefore in spreading the brood nest, the consumption of food is a factor.

If the bee-keeper desires to have a large harvest of honey then he would do well to have his colony as strong as possible by increasing the population just at the beginning of the honey-flow season. This can be done by inducing the queen to lay eggs profusely by adopting stimulative feeding 42 days in advance of the opening of the main flow of honey in

the spring—forty-two days because, 21 days for brood rearing and about another 21 days for the nurse bees to begin work as foragers. But this artificial feeding early in the spring, hastens the 'Swarming Fever' of the bees by about one month to one month and a half. To obtain the maximum surplus, and for that matter, any surplus of honey, swarming shall have to be controlled. (See 'Swarm and Swarm Control', Chapter - 25).

(3) **To Prevent Shortage of Food and Starvation :** Injudicious extraction of the full harvest of honey will leave the bees, at the close of the honey-flow season, without sufficient food to carry them through the rains and the winter. During the rainy season, little foraging is possible because only a few nectar-yielding flowers are in bloom, pollen and nectar also wash out on account of the rain, and the activity of the bees slows down. The population also decreases, because, with the cessation of the flow, breeding declines. When no nectar is flowing to the hive and the last drop of honey is consumed, naturally there would be no other alternative to the bees than to abandon the hive for good, or start robbing and fighting. (See 'Robbing and Fighting', Chapter - 19). But before such a crisis comes, it is for the bee-keeper to supplement their supply of food by feeding sugar syrup once or twice a week according to their necessity.

Nectar is scarce in winter. In some areas in the Plains, the autumn flow after the rains is not much. It may or may not give any surplus honey to the

bee-keeper. And in some areas it may not even be sufficient for the bees to pull through the winter. It is to the interest of the bee-keeper, therefore, that honey should not be so extracted during the main flow that the bees may be put to difficulty. But whenever their food runs short, it would be wise and profitable to feed them artificially.

It must be remembered that sugar cannot be as good a food for the bees as honey. They may be fed with honey diluted with water. But the bee-keeper may not like the idea of feeding the honey back to the bees once it is got. The best thing would be to give them a comb of sealed honey, if available and can be spared from any other colony.

When there is sufficient stored honey in the upper part of the brood combs or there are honey combs full of sealed honey and the bees are reluctant to open the cells, then expose some honey by piercing or pricking the cappings with a penknife here and there, and thus make them consume the honey. The bees will start eating up as soon as it will be oozing out. This will help the bees to some extent.

In the Plains, it is found that good honey in the hives, stored and well sealed in the spring, ferments during the rainy season, and the cappings bulge out in patches. This fermentation is due to the absorption of moisture from the air which is so wet during the rains. The bulged cappings should be sliced off, otherwise these will be joined up by the bees to the comb beside, and will be a source of inconvenience during manipulation.

Precaution in Feeding :—While feeding the bees, contract the entrance of the hive to one or two-bee space if the colony be weak. For a strong colony the entrance may be widened a little more. This contraction of the entrance is intended to give a better facility to the bees of the hive in resisting the possible intrusion of robber bees inside. To avoid the stirring up of any robbing tendency, the syrup must be given late in the evening when the bees have practically ceased flying. Do not keep the top of the hive open for a long time while giving the food. Do not spill the syrup or expose the honey comb anywhere near the hives, or do not act in a way that may excite the bees to robbing.

When feeding has been taken recourse to in comb-building and raising the population, too liberal feeding will induce the bees to store the surplus in the cells that have been newly built or are otherwise empty, instead of using them for rearing the brood. Therefore slow but continued supply should be maintained.

Preparing Syrup :—For feeding in (1) the spring and summer, take sugar 4 lbs., water 2½ lbs. and Thymol one grain ; (2) for the autumn, sugar 4 lbs., water 3 lbs. and Thymol one grain ; and (3) for the winter, sugar 4 lbs., water 3½ lbs. and Thymol one grain.

In preparing the syrup, use white cane-sugar crystals. Place a pan on fire and prepare the syrup by pouring the sugar slowly into the hot water and stirring it continually till completely dissolved. Crystals, if allowed to settle, will stick to the bottom in a mass,

and if burnt will be unfit for use. Raise the liquid to boiling and keep so for five minutes over a slow fire. Allow the syrup to cool down slightly, then add Thymol and stir the syrup vigorously, strain through a fine sieve or through a piece of cloth, and store it in a tin can properly closed. The addition of Thymol to the syrup is to prevent fermentation. The syrup so treated gives perfect satisfaction.

Thymol is a white crystilline substance obtained from the volatile oil which comes on steam-distillation of the *Ajowan*. It has a pungent aromatic taste and odour. It has powerful antiseptic properties. It irritates the bare skin on touch. In weighing Thymol one must be very careful so that it may not come in contact with the fingers. It can be had of any dispensing chemist's shop @ Rs. 6 per pound, and about Rs. 1/10 for a quarter pound. (Pre-war rate quoted).

White crystal sugar is surely the right stuff for the preparation of syrup in all normal times. But in an abnormal time when no sugar, white or brown, is available for the bees, what would the bee-keeper do? One way is to bring down the total number of colonies by eliminating the weaker ones by uniting and thus relieve pressure. Yet those that are left must be saved. He may try 'Jaggery' *(Ukh-ka-gur)*. The sprup may be made from jaggery by adding water in the same proportion and following the same process as in the sugar.

The jaggery as obtained from the market may be slightly acid in reaction. It should be neutralised by the addition of small quantities of Sodium Bicarbonate

as the syrup will be boiling. Vigorous ebullition takes place as soon as Soda is added to the boiling syrup. It should be added, say, five to ten grains at a time and stirred. For 4 lbs. of good jaggery, more than 35 grains of Sodium Bicarbonate may not be necessary. But after all, it depends on the quality of the jaggery used. The addition of Soda should be continued thus until the reaction ceases. Thymol should then be added as directed. The syrup should be strained through and allowed to settle for the night; in the next morning the clear liquor should be decanted and stored for use.

Jaggery syrup, as prepared above, has been tried by the author. Some of the colonies accepted it though not with much avidity, while some others won't touch it even for days, but ultimately had to satisfy themselves with what they got. Compared with the sugar syrup, quantity per quantity, the bees take a long time to suck up the jaggery syrup. No after-effect was noticed in any of the colonies, but it is too early to come to any definite conclusion.

Sodium Bicarbonate commonly know as Soda Bicarb is antacid and used in the diseases of digestive system like dyspepsia, acidity, etc. Soda Bicarb tablets, 7 grains or 10 grains each, can be had of any dispensing chemist's shop. (For its use in bee sting, see page 31).

Preparing Candy:—When solid food is to be given to the bees, instead of the syrup, a few pieces of *Batasa* may be placed on the top bars of the frames in the hive, or kept in a small dish and the latter

placed on the frames. 'Batasa' if slightly moistened with a drop or two of water, will be eaten up by the bees very quickly.

Candy may be prepared in the following way. Take granulated sugar one pound, Cream of Tartar 10 grains, and water 4 ounces. Boil the water in an aluminium cup, remove it from the fire and add the weighed quantity of sugar and the Cream of Tartar, and stir until the sugar is partly dissolved. Then place the cup on fire and go on stirring the mass until it begins to boil. Continue boiling for about 2 minutes stirring all the time and when the mass begins to thicken, remove the cup from the fire and place it in cold water until it begins to be cloudy. Remove the cup from the cold water and then stir the mass vigorously with a small stick until it begins to whiten, and then pour it out, with the aid of the stick, in small quantities on an aluminium or brass plate previously oiled slightly and cleanly wiped off with a small piece of cloth. Small cakes of candy will now be got. It may also be poured into wooden moulds to get cakes of desired shapes.

It should be noted that the correct boiling of the mass is important before the cup is removed from the fire to be placed in the cold water. The right point is to be ascertained by taking samples from time to time and allowing the same to drop on a cold plate and then pressed between the fingers. It must not give a sticky feel but set soft so that it may be rolled. A sticky feel will indicate that a little more boiling is necessary. One would do well to try its preparation

only in small lots and thereby get the proper knack through experience.

But *Batasa*, as stated above, is quite good and will serve the purpose well. It may be prepared in the same way as the candy, the only difference is that after the mass is being boiled for two minutes, instead of placing the cup in cold water, stir the mass vigorously after its removal from the fire and allow it to drop in small lumps on the plate.

Pollen and Pollen Substitute:—The pollen as a food for the young bees and larvae is important for it supplies the necessary protein. (See 'Food of the Bee', page 54). The pollen which is stored in the hive during the honey-flow season may be quite sufficient to carry the bees through. It is also gathered to some extent during the other seasons. (For the *pollen-dance* of bees, see 'Dance on the Comb' in Chapter - 22).

As a substitute for pollen, when there is scarcity, some bee-keepers recommend the use of wheat flour, pea meal, cotton-seed meal and meal of different kinds of grain, offered to the bees in the form of a paste being mixed with honey, or sprinkled on a tray mixed with chaff. But the general conclusion is that these substitutes, though they stimulate egg-laying, have little value as food because these cannot be properly digested by either the nurse bees or the larvae. Soy-bean meal is also suggested by some. A good substitute is a necessity and if found will be very helpful. The scarcity of pollen in a hive can be met to some extent by giving it a comb containing pollen from another hive that may have a surplus.

CHAPTER XIII

HANDLING THE BEES

It is a treat to see an expert lifting a comb full of thousands of bees from the hive with bare hands, and face unprotected, and calmly examining it at close quarters. To an unaccustomed eye it may seem as a miracle. But it is the confidence of the bee-keeper that makes him appear to be immune from stings like a charmer. There is no mystery behind it. It is undoubtedly an art which every bee-keeper has got to learn through experience gained by the cautious handling of the bees. Graceful handling cannot be learnt in a day; it comes by practice only.

When to Handle:—Bees can be handled at any time of the day, out of necessity. For, in bee-keeping, as in every other thing, necessity has no law. But it is best to tackle them when they feel least disturbed.

In the early morning and late in the afternoon they are busy in foraging. They may not be disturbed during that time. At noon during the summer, being oppressed by the scorching rays of the sun and heat, they slacken their activity and practically remain inside. So, in the summer, the bees may not be disturbed at noon. Then again, weather is a great factor in the behaviour of the bees. During cloudy and

rainy days, they should be left alone. The hive may not be opened when a high wind is blowing. A bright day is best for all purposes, and for *usual examination*, the hive can best be opened at about 9 A.M.

In handling the bees it must be noted that the old workers are very irritable. Liberty can be taken to some extent with the young ones. At times the bees behave badly which may appear to be without any reason. But on close examination it can be traced to several exigencies. If on approaching a hive or opening the top it is found that a worker has marked the bee-keeper and is vigorously circling round him, cutting a hurried zigzag course with a sharp booing sound, then take note that she is angry. Her irritation will at once excite others. It will be best to leave the hive for the time being, for it may be that in attempting to handle a frame the bee-keeper will be hailed with a lot of stings.

How to Handle:—Concentration of attention on the work in hand, and training the mind to record what the eyes see, are essential in dealing with the bees successfully. As has already been stated, hands and face should be protected by the beginner. It will not only give him confidence but will also save him from the disfigurement caused by stings. And it is probable that he will feel shy to appear before a friend or a visitor with the face swollen.

Frames should be handled gently but firmly. There should be no quick movement of hands or appliances over the frames or near the comb under examination. One must not breathe directly upon

the bees. There should be no shouting and loud laugh or talk with a comb in hand kept in front, for the bees will be excited by the sudden flow of air on the comb caused thereby. If any direction is to be given to an assistant near at hand while manipulating a frame, or if anything is to be explained to an interested visitor who happens to be present at the time, turn your face aside and speak slowly.

Subduing Bees :—It has been stated before that the 'Indian Bees' do not generally require to be subdued by the application of smoke (page 93). The hive can be opened and the bees handled with perfect ease without its use.

To control a vicious stock, three or four puffs of smoke at the entrance will be sufficient to calm down the bees. The hive should be opened a few minutes after the application of smoke when the jarring sound inside has subsided.

Unnecessary Handling :— Beginners in their enthusiasm are ever ready to satisfy the curiosity of their friends by opening the hives and handling the combs to show the working of the bees. When once a comb is shown and explained, the bee-keeper is next asked about the queen and a desire is expressed to see her. And the bee-keeper goes on lifting the other combs to search the queen out. This weakness must be avoided by politely telling that such manipulation retards the daily progress of work of the bees caused by the disturbance, requiring time to settle down again. It lowers down the hive

temperature requiring extra work from the bees to raise it, which must be maintained at about 98° F. for brood rearing. It exposes the brood which require warmth, and it annoys the bees. Unnecessary manipulation must, therefore, be avoided at all times.

Regular Inspection:— A visit should be paid to the apiary every day in the morning when the bees fly most, and also in the afternoon when they again become active or in the evening when they come back from the field. Regular inspection of hives is essential in order to ascertain the population of the colony, the condition of the combs, the amount of brood, and cleanliness of the bottom board. Accumulation of refuse matters, however small a quantity it may be, is dangerous. It indicates that the hive requires cleaning, for, in all probability, a careful search will reveal the presence of caterpillars, small or big. The cappings of drone cells and very small bits of combs accumulated on the bottom board serve as a good breeding place for caterpillars. The hive should be changed without hesitation in case the bottom board is found dirty.

Hives may be examined once every three weeks, and even earlier, if the movement of the bees cause any suspicion. Examination of hives once a month may also do if the colony be strong, the bees move freely and bring pollen, and the alighting board be quite clean. To avoid a lot of troubles from caterpillars, it is better to change the hive once a month at the time of its examination or earlier if thought necessary.

The alighting board often serves as an index of the condition inside the hive. Black pellets near the entrance show the presence of caterpillars; the cap of a queen cell or any of its demolished portion will indicate the birth of a new queen or an attempt in that direction; small particles of wax will indicate that the bees are opening out the capped honey-cells. Every bit of refuse matter on the alighting board will indicate the condition of the hive one way or the other.

Searching the Queen :—While examining the combs one may be sure of the presence of the queen if there are eggs in the cells. But it is good to make it a point to see the queen in order to mark any changes in her size and appearance. At the end of the honey-flow season, the queen generally looks lean and reduced in size.

The colour of the Plains type of queen as she emerges from a cell looks dull, but it develops within a few days. She looks fairly big, flabby and heavy as she emerges, but in about three or four days she becomes lean. She regains her size on mating and the abdomen distends fully within a few days. The tip of the abdomen of the Plains-type queen darkens in colour due to old age and she loses her gloss also, while the black Hill-type queen looks light grey.

Finding the queen out is not difficult. Pass a hurried glance over the face of the comb from end to end and she may attract your eyes, if not, search for her carefully. Either she will be found laying egg with the abdomen thrust inside a cell, legs spreading

out over other cells and the head looking down, or she may be moving about in search of empty cells or idly sitting being encircled by the workers and caressed. The light-yellow legs and the bigger body, a ring of workers or a small cluster of a few bees on the comb will at once mark out the queen. She may be carefully searched for in a comb having fresh eggs. The eyes once trained will be able to spot her out quickly.

Manipulating the Frame :— Before attempting to handle a comb full of bees for examination, one must know the proper way of holding it and turning it over, to bring the other side in view. It would be good to learn it by practising with an empty frame. When a comb is not wired and an attempt is made to turn it directly over, while holding it horizontally as taken out from the brood chamber, the comb is sure to break and drop down. It is, therefore, necessary to know the right way of turning the comb.

Now, as to turning the comb. The frame should be raised vertically by holding the shoulders as has been stated. (See Fig. 64). After the examination of the nearest side, to bring the other side in view, raise the right hand until the top bar is perpendicular; give a half turn to the frame towards the left and then lower the right hand. The bottom-bar will now be found at the top and the other side of the comb will be exposed to view. To bring back the original position, raise the right hand up, till the top-bar is perpendicular, give a half turn towards the right and then lower the right hand till the top-bar is horizontal again.

Fig. 64. Manipulating a comb to bring the other side in view.

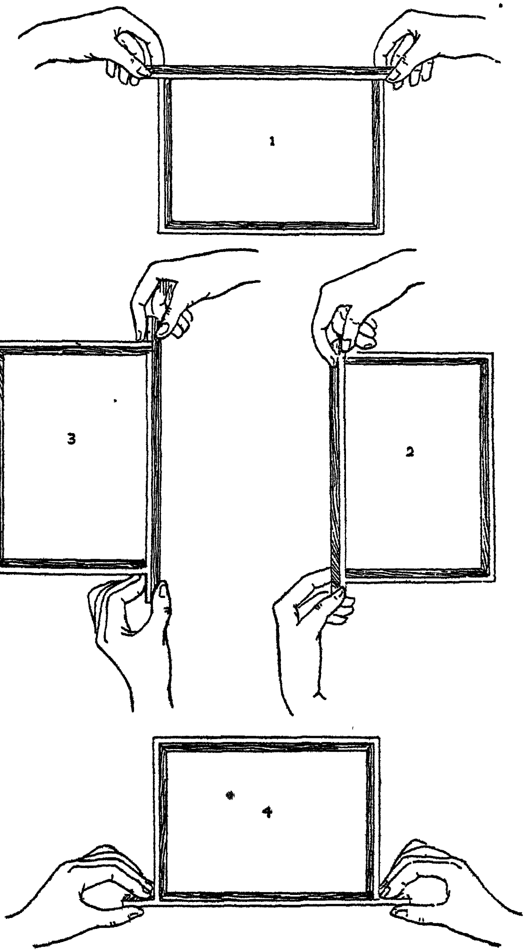


Fig. 1. Shows the first position of frame.
Fig. 2. The second position. Frame will now be turned to the left.
Fig. 3. The third position.
Fig. 4. The fourth position. The other side is now in view.

Now, open the hive and remove the super. Draw back the dummy board a little, remove it from the brood chamber, and thus get space to lift the combs. When the brood chamber contains frames to its full capacity without the dummy, take the comb beside the wall and draw it back slightly by holding its shoulders, and then raise it slowly taking care that the bees are not pressed. Bad manipulation may injure the queen if she happens to be in it or in the one just beside. When the examination of the first comb in hand is over, place it on a frame-stand or in an extra brood chamber arranged before-hand, so that there may not be any difficulty in lifting the other combs one by one and examining them. Remember always that whenever a comb is to be lifted, it should be drawn back first and then raised slowly.

In trying to draw back a comb, if it is found that it has been joined up by the bees to the next comb, then hold the shoulders of the frame to be raised with the thumb and the index finger, press down the next frame with the aid of the middle fingers, and then while drawing back the frame try to raise it up, keeping the frame under the full control of the thumb and the index finger. Slightly raise one shoulder first then lower it down. Next, attempt the other shoulder. Repeat the process until the points of attachment give way, and then raise the comb. Remove the extra wax at the joints or the brace-combs with the penknife.

In examining a comb turn your back towards bright light so that full light may play on the comb. Hold the comb above the hive so that the queen, in case she misses her grip, may fall in the hive. The queen may be noticed at times playing hide and seek with the bee-keeper; when exposed to view she will at once go over to the other side, and when the comb is turned bringing her again in view, she will move away hurriedly to the other side or conceal herself in any small space that she may find between the comb and the side-bar or in any corner.

Do not frighten the queen or tease her in any way. When frightened in the course of laying, she will hurriedly withdraw her abdomen from the cell, and if she has not completed laying, a tiny, white and slightly curved, cylindrical egg, about 1/16th inch long, may be noticed sticking to the ovipositor.

If at any time during the examination the queen after leaving the comb moves on directly to the bare frame, then put the comb again in the hive without delay, for she may take wing. And if the queen flies away, the best course would be to step a few paces back from the hive after keeping it open, and wait patiently for her return.

A virgin queen is shy and restless. When she takes a long time in mating and is in the habit of going out to take her chance, she sometimes takes wing from the comb taken out for examination. She will be found to circle round the hive for a few seconds and then will come back to the hive. She may alight on any other support near-by. In that case, pick up

the queen lightly and enclose her within the palm and then release her on the top bars of the frames. The combs under examination must not be kept unnecessarily exposed for a long time, as by that the brood may be chilled in cold and wet weather, and may also be badly affected on account of excessive heat during summer.

Removing the Bees:—In order to remove the bees from a comb, hold the frame rigidly by pressing the two side-bars with the palms and place the

Fig. 65. Bees removed from a grub comb, showing sealed honey in the upper part, and capped brood in the middle.

thumbs on the shoulders of the top-bar. Hold the frame thus in a tight grip and shake off the bees on the ground in front of the hive with one vigorous jerk, or two or three jerks in quick succession. The few bees that will still cling to the comb should be removed by blowing them off or brushing them out with a feather. This method is quite easy and can be

adopted with satisfaction. After shaking down the bees, step back immediately. The bees will then take wing and go back to the hive ; the few young bees that cannot fly and are left on the ground may be placed on the alighting board with the feather. The bees may also be shaken off on a hiving-board instead of on the ground. Before removing the bees thus from a comb, one must be sure that the queen is not in it.

Another method is to hold the frame by one of its shoulders very firmly in the left hand, keeping it a few inches above the ground or the hiving board, and then with the right fist to give a sharp blow on the left wrist. The bees will drop down. But it has been found that freshly-gathered honey splashes more in this case than in the former. Then again, there is the risk of a heavy comb losing the grip and dropping down.

So far as the Hill-type of bees are concerned, instead of shaking them off, they may be made to move away from the comb and gather on the top-bar by a few smart taps at the side-bar of the frame with the handle of the penknife, and if the shoulder be now placed on the alighting board in a slanting position, the bees will march at once for the entrance.

The use of 'bee-brush' is suggested for clearing the bees. The use of feather is also suggested by some for the same purpose. But an attempt to brush off the whole lot of bees from one side of a comb with a feather would only irritate them and in that event the retaliatory measures that would be taken by them may not be very pleasant to the operator.

Whatever method is adopted one must be sure that the combs are wired, and when a comb is not wired he must proceed very cautiously. Of course, the shallow frames, $2\frac{1}{2}''$ in depth, used in the supers of the Newton hives do not require wiring. When the bees are to be shaken directly into the hive, over the frames, see that an empty super is on the brood chamber and that the top is closed with a pasteboard as soon as the bees are shaken in.

CHAPTER XIV

SPRING AND SURPLUS HONEY

A strong healthy colony and a suitable locality having nectariferous plants and trees are conditions precedent to get a good harvest of honey. A fair weather condition is also a factor. On the approach of the spring do not leave the bees to themselves. Stimulate the queen to lay more eggs, as also stimulate the bees to comb-building and brood-rearing by feeding the colony artificially *at the right time.* (See page 167). Supply more frames, enlarge the brood nest and thus bring the stock to overflowing strength so that when the honey flow begins, bees may store honey in the super. (See Chapter - 12).

Honey Season and Swarming :— One must remember that the honey season is swarming season too. Swarming is the natural method of the bees in dividing themselves and thus increasing their race. They do it by instinct. Swarming is a necessity with the bees for the purpose of reproduction. It is caused by natural impulse. It is a process by which a good number of worker bees along with the reigning queen or a virgin queen and a few drones leave their old home and establish a new home in a suitable place elsewhere, leaving the greater portion of the bees, a virgin queen or one or more ripe queen cells or queen

larvæ in the old home, and some drones. If a colony be left undisturbed, a number of swarms will issue out till the population dwindles hopelessly. From an uncontrolled colony having 7 standard frames with bees adhering three to four deep, the author had occasion to see 9 swarms issuing out in 11 days. (See 'Causes of Natural Swarming', in Chapter - 25).

The first swarm that issues out of a colony is called the *prime swarm,* and the after-swarms are called *casts.* The first after-swarm is the 1st cast, the next one is the 2nd cast and so on. From the colony mentioned above, throwing out 9 swarms, the 1st cast came out on the third day, the 2nd cast on the fourth day, the 3rd on the fifth day and thus they came out one cast a day with the exception of one which had a day's interval. The maximum interval observed between the issuing out of the prime swarm and the first cast from a number of uncontrolled colonies was 5 days.

The prime swarm takes away a good lot of bees from the parent stock, and the casts become smaller as the stock is being depleted by each division. A prime swarm from a very strong colony having 11 standard frames was found to contain about 12,000 bees. It should be noted here that the size of the bee varies according to the altitude of the place. (See page 105). The higher the altitude, the bigger is the size of the bee. The district of Dinajpur is in North Bengal where we get Hill type of bees. Dinajpur town is situated directly 100 miles to the south of Darjeeling (altitude 7,500 ft.), and within this distance

of a hundred miles down towards the sea, it has been found that the size of the Hill-type bees at the former place is smaller than that of the latter, and consequently the weight is also less. It may be further noted that the Indian Bees of the Plain-type, as found at Sodepur, number about 12,000 a pound, and the Hill-type of bees as found at Dinajpur, number about 9,000 a pound. The European bees number about 5,000 a pound.

The bee-keepers' concern is honey for which bees are kept. Swarming, though necessary for the bees for their propagation, by reducing the population of the colony, adversely affects the storage of surplus honey. It is, therefore, that the bee-keeper cannot afford to allow the bees to divide themselves thus, if he has a mind to get a good surplus of honey. To reap the harvest, he must take every possible precautionary measures to check the swarming of the bees. (For full details, see 'Swarm and Swarm Control', Chapter - 25).

A triangular race goes on between the queen mother, the foragers and the bee-keeper. At the height of the season the queen wants to lay more eggs and finds very soon that there are no further empty cells to lay in eggs. The workers are mad after foraging, and in the race soon find that there are no more empty cells for the storage of honey ; drones are born, queen cells are produced, the hive is congested. But the bee-keeper must run for the race in advance of his bees. He must give them more accommodation and relieve the congestion, control

drone breeding, check the production of queen cells and give them further empty combs to store honey or empty the honey combs as soon as they are capped and return the empty ones to the bees to be refilled.

Supering :—This is arranging frames or 'sections' above the brood chamber to receive the surplus honey. Shallow frames are intended for the production of extracted honey, and sections for 'comb-honey'. (About sections and comb-honey, see 'Comb Honey', page 197).

When the brood chamber is full of bees, the cells are full of grubs, and enough honey has been stored in the deep combs, the bees creep up to the super in search of space and build combs in the roof if shallow frames are not placed in the super in time.

Examination of the hive will show that the four sides of the empty super are crowded with bees just above the brood chamber and the top bars of the brood frames are full of bees, some vibrating their wings and thus drawing out moist air and helping the fanners at the entrance in getting fresh supply of air. Bees will also be found adhering to the wire-netting of the two upper ventilators and fanning out the exhaust air. The ear, placed near the ventilator at the back of the hive and on the side-walls of the brood chamber, will indicate, by the increased volume of humming, the heavy work that is going on within.

When the hive becomes overcrowded, a good number of bees will be found at night clustering at the hive-entrance. Sometimes the bees will cover the whole of the alighting board. But before such a

crowding takes place one must be prepared for the issuing out of swarms. It will now be understood that unless swarming is checked, no surplus honey will be available, for, there will not be enough bees to work in the super.

Before the crowding begins, the bee-keeper must arrange for the starting of the work in the super. Begin by placing in the middle of the super, two shallow frames having combs built in them or frames with guides or foundation fixed. Go on adding frames as the bees will be building combs and storing honey. For a Newton hive of seven-frame capacity, add six shallow frames in all, by increasing the number from time to time. When the flow is coming in, examine the super regularly and go on extracting honey.

It is better to extract those combs that are fully sealed, but in no case should honey be extracted before the combs are at least three-fourths sealed. Instead of waiting for all the combs to be capped, those that are ready for extraction may be taken out and extracted, replaced by empty ones or frames fitted with comb-guide or foundation. (For 'Extraction of Honey', see Chapter-16).

Another method may be adopted. When combs are built in the super and stored with honey to the extent of about two-thirds, then lift this super and place a second super underneath it, filled with empty combs or frames fitted with guide or foundation. Combs in the first super will thus get time for all the cells to be filled and the honey to be ripened. A third and a fourth super may be put on; or, the

combs of the first super may be extracted as soon as matured, replaced by the combs of the second super, while the latter receive the combs of the first super immediatly after their extraction. In any case, so arrange that while one set is being taken out for extraction another set may be returned to the bees to be refilled. Work must continue unhampered. There must not be any unnecessary delay that may retard the progress of work, and thus curtail the total yield.

Fig. 66. Shallow Comb : Newton size.
It is full of honey with the bees adhering.

The two side-combs in the brood chamber usually contain honey exclusively. These may be extracted. But it must be noted that the extraction of these two combs will retard the progress of work in the super, because once these two combs are extracted, bees cannot be expected to work in full vigour in the super till these two are filled with honey again.

Bees work merrily in the supers of the Newton hives, for which no effort is needed from the

bee-keeper. Rather, they go ahead and surprise him by building burr-combs on the upper part of the top bars, raise these combs three to four inches up, fill the cells with honey and cap them, if shallow frames are not arranged in time. These combs should be cut out carefully. In the absence of a hive-tool or a scraper-knife (see pages 94 and 95),

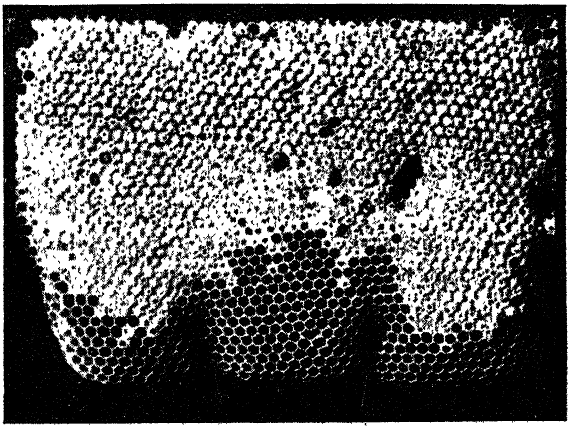


Fig. 67. Deep Comb : Newton size.
It is full of honey and the cells are capped except only a few in the lower part.

an one inch wide carpenter's chisel will do. Slowly push the sharp edge underneath the comb. While removing the burr-comb thus, hold the top bar tightly by pressing it down so that the frame may not move either to the right or to the left.

Queen Excluder :— The queen-excluder (see page 112) need not as a general rule be placed between the brood chamber and the super, for, it is surely a

hindrance to the bees so far as their free movement from the lower to the upper chamber and back, is concerned. In the Plains we find that the queen rarely comes to the super for egg laying. When a queen is detected in the super, lower her down with a feather, or place the shallow comb containing the queen beside a brood comb for a few minutes and blow some air and the queen will move away. The queen excluder should now be interposed to prevent her from ascending to the super.

The excluder successfully prevents the queen from coming to the super, but on a rare occasion, when she is bent on creating the mischief, she will somehow manage to squeeze herself through the slot and come to the super. And we know cases when the queen, in spite of the queen excluder, came to the super, laid eggs and then went back to the brood chamber as if nothing had happened and the result was that queen cells were produced in the super; and sometimes the opposite also happened, the queen stayed in the super and queen cells were produced in the brood chamber. A careful eye has to be kept, and the colony must be examined every week regularly once the queen excluder is interposed.

Removing Queen Cells :— Before the honey-flow begins and when honey is flowing, brood combs should be examined carefully for queen cells. Bees will be found to be so crowding the combs that it may often be difficult to examine the edges of the combs. Slightly blow air on the bees at the edge when they will move away and the edge will come in view. Pinch out all

the queen cells from all the combs. But before that, try to find out the queen. If she is not found due to over-crowding, be satisfied by finding eggs and fresh grubs in the combs. (See 'Re-queening the Colony', page 161).

Queen cells can be easily pinched out with the sharp point of the penknife. Wear the veil, clear the portion of the comb by blowing air, and remove the cells by carefully cutting them out. Go on blowing air slowly so that the bees may not approach the cells, and remove them one after another. One must remember that the bees have a great attraction for these cells and the larvæ within, as also for the worker and the drone grubs in the cells roundabout. While cutting out the queen cells, one may injure some drone or worker cells. The smell of the crushed larvæ irritates the bees very much.

In cutting out the queen cells, hold the frame vertically in the left hand with the bottom bar facing the operator. Place the little finger or the fourth finger of the right hand on the bottom bar, and while supporting the right hand thus, hold the knife with the thumb, the index finger and the middle finger, for removing the cells. The support thus given to the right hand will prevent the unintentional jerk to the frame caused by the effort in pushing the knife and removing the cell. It is good to remember that the slightest jerk will now make the bees furious. If it becomes difficult for the beginner to remove the cells by holding the frame in the left hand for a long time, then the frame can be made to stand firmly on one

of its shoulders on a small table or on a stool, and then the removal of cells may be attempted.

All the combs have got to be examined for queen cells. A regular examination on every day week and removing the queen cells thus, will check the possibility of swarming. There are other methods of controlling swarm to which we shall come later on. (See Chapter - 25).

Standard-frame Hives and Supering :— It is difficult to induce the bees, in the Plains, to work in the supers of the standard-frame hives. They are very reluctant to do it. They would rather build brace-combs, build burr-combs and store honey, raise a second series of cells over the capped honey cells in the upper part of the combs, and would elongate the honey cells near the top bars and make them bulge out than build combs in the shallow frames in the super. The direction of these bulged out cells are always slightly upward. The cells at the right or left hand corners are slightly inclined towards the right or left as the case may be. (See 'Different kinds of Cells', page 44).

In order to get honey from these hives, it is better to use the 'Division Excluder'. (See page 114). This excluder may be suspended like an ordinary frame in the brood chamber. Exclude two to four combs heavily loaded with honey which are intended to be extracted, though they may contain a few grubs and eggs. Place them beside the wall of the chamber, interpose the division-excluder and then close up the grub combs. In the excluded combs

beside the wall, queen cells must be expected if there are grubs and eggs in them. Examine the hive a week after and remove the queen cells from the excluded combs. Young bees will also be emerging out of the sealed cells, and in due course the comb will be free of larvæ and pupae and will be ready for extraction.

The honey should be extracted as soon as the combs are removed from the hive, and the empty combs returned to the bees immediately. They will store honey in these empty combs, but the queen will have no access on account of the excluder. These combs may be taken out again after a week or so soon as they are full and matured for extraction. Of the empty combs, some may be interposed between the brood combs alternately for egg laying, and some may be excluded for the storage of honey for extraction.

The side-combs may be found to contain honey and pollen exclusively. Of these combs, those containing pollen mostly, must be left alone, and those containing a few cells of pollen, may be taken out for extraction. But one must be very careful in extracting such combs, and rotate the cage slowly so that pollen may be left in the cells undisturbed.

In the Hills, in Northern India, the main flow occurs in autumn. The general practice of the bee-keepers there is to extract honey at the end of the flow, when all the honey is in, and the combs are capped.

Comb Honey :—Surplus honey, as has been stated before, may be got in two ways,—(1) by working for extracted honey with shallow frames in the super, and (2) for comb-honey in 'Sections', ready for use

as soon as it is removed from the hive. We have until now confined ourselves to the description of the methods of receiving the maximum surplus of extracted honey. We give here only the barest description of the production of comb-honey. It is no good trying for it unless the apiary is situated in an exceptionally good locality and the flow is coming in profusely. It requires the strongest colonies to produce comb-honey, but the yield on the other hand is comparatively less.

To obtain comb-honey, 'Section Rack' is used. It is a framework to hold 21 sections, placed above the brood nest. The rack may be taken as a super for comb-honey. The 'sections' are cases made of wood having only four sides, and measure $4\frac{1}{4}'' \times 4\frac{1}{4}''$ and $2''$ wide. They stand in seven rows, three in each. The sections are fitted with full sheets of foundation, placed in the rack and held fast by means of boards and spring locks. Bees build combs, store honey and cap the cells. Each section can hold about a pound of honey.

The extracted honey is sold in bottles or in tin cans; but in comb-honey, the honey is sold along with the comb as its container. The comb requires a nice appearance and a special finish to make it saleable; the cappings also must not have any stain. In the extracted honey, the combs are used over and over again, whereas in comb-honey the combs go to the purchaser. Considered from all stand-points the comb-honey is a costlier article.

CHAPTER XV

THE HONEY FLOW

Sources :— Honey should be treated as an agricultural by-product. Sowing field crops exclusively for bee-forage cannot be considered as a profitable enterprise. Whether as a spare time occupation on a small scale or as a business proposition on a large scale, the bee-keeper shall have to count on the neighbouring fields under cultivation, the fruit and flower gardens in the vicinity and the natural sources of supply as may be available from the innumerable wild nectariferous plants, trees and shrubs in the area.

If the bee-keeper possesses a piece of land which is poor, unproductive or otherwise useless for ordinary cultivation, he may turn it, and for the matter of that every available corner, into beautiful plots of flower gardens. He may plant Cockscomb (*Murga-phul*), Cosmea, Marigold (Indian variety), Nasturtium, Poppy (single), Portulaca, Sunflower, Zinnia (single) and such like flowers, according to the season. Some of these flowers yield pollen, some nectar and some both. The *Bussora* roses are also visited by the bees.

The perennial climber Antigonon may be grown in the Plains. Its blossoms are of great help during the rains when the sources of supply become limited and scarce. Antigonon serves well the purpose of a screen. (See page 116).

A few names of plants, trees, shrubs, creepers, climbers and field crops are given here which yield either nectar, or pollen or both when in flowers,—

Apples
Apricot
Babool, *Babla* (*Acacia arabica*)
Baer (Plum)
Batabi (Lemon tree)
Brinjal
Bun (a forest tree of the Sundarbans)
Clover
Cocoanut
Cotton (*Gossypium*)
Date-palm
Gab (*Diospyros Embryopteris*)
Gewn (*Excoecaria agallocha*, a forest tree of the Sundarbans)
Guava
Hijal, *Ejar*
Jaman (Black-plum)
Kadamba (*Anthocephalus Cadamba*)
Karanj (*Pongamia glabra*)
Kumhra (Gourd or Sweet Marrow)
Litchi
Lotus
Mahua (*Bassia latifolia*)
Mango
Mustard
Mutha, (*Cyperus rotundus*)
Nag-kesar, *Nagessur* (*Mesua ferrea*)
Neem (Margosa)
Oranges
Palang (Spinach)
Palm
Pears
Piring ('*Sprikka*' in Sanskrit)
Plantain
Punarnava (*Boerhaavia*)
Ritha (Soap-nut)
Sajina (*Moringa pterygosperma*)
Semal, *Semar* (Silk-cotton, *Bombax malabaricum*)
Tamarind
Til (Sesame)
Toon (*Cedrela Toona*)
Ulu-grass (*Imperata arundinacea*)
Wild Himalayan Cherry

During the rainy season, bees are seen visiting the flower spikes of *Mutha* or *Musta* and *Ulu*-grass for pollen. (Dried Ulu-grass is largely used in thatching). In the very early hours of the morning during this season, before the sun rises, bees collect pollen from the big globose heads of *Kadamba* flowers. *Punarnava* yields nectar.

Palang-sag is cultivated everywhere as a vegetable. Its flower spikes yield good nectar. The yellow flowers of *Piring-sag* is also another source of nectar. Bees collect both pollen and nectar from the flowers of *Kumhra* (*Mitha-Kumhra*).

The flowers of Mustard yield plenty of nectar, and the honey which is very nice, granulates within a very short time.

Cotton flowers yield nectar. Mr. S. Ramachandran in "Bee-keeping in South India" (Bulletin No. 37 of the Department of Agriculture, Madras), gives a note about *Cambodia cotton.* He says that the crop is generally sown by September—October and begins to flower by November—December. The first flush continues till February and then again there is a second flush during April or earlier. He then writes about its honey-yielding capacity thus :

> "Round about our apiary cotton seems to be a very good honey-yielder. On a very rough estimate an acre of this crop seems to be capable of yielding more than 10 lb. of honey during a season but the possibilities are certainly greater and require further elucidation."

We have in our garden at Sodepur some *Deva-kapas* or *Budi-kapas* and *Jata-kapas* plants. These are tree-cotton plants. They flower all the year round to some extent and more profusely by the early part of December which continues till February. The second heavy flowering starts by the middle of April, and yet a third by the end of September. But the bees here rarely visit these flowers.

The bee-keepers in the cotton areas in India will be interested to find in the following quotation from Root's "ABC and XYZ of Bee Culture", the amount of nectar secreted by cotton plants :

> "In Louisiana bees are said to be seldom seen on cotton, although it is the staple crop. In the Arkansas River Valley in Arkansas there is an immense acreage of cotton, and 96 pounds per colony in an apiary of 12 colonies was obtained chiefly from this source. In the Pulaski County at Sulphur Springs a great amount of cotton honey is secured. It is in Texas that cotton rises to the rank of a great honey plant, where it yields nearly one-fifth of the entire crop of honey produced in this state."

Kamala-nebu is the name by which oranges are called in this part of India. The Sylhet orange or more correctly the Khasia orange is well-known in Bengal and Assam. The name *Kamala-madhu* is also quite familiar and this *orange-flavoured* honey is highly prized by all. But it is got by the old method of squeezing out the combs of the wild colonies. Keeping bees near the orange gardens under modern

methods will be helpful in the extraction of pure *Kamala-madhu.* The Darjeeling and Nagpur oranges are well-known. There are several orange plantations in different parts in India.

Bees collect nectar from the mango-blossoms merrily. Of the various names of mango, *Pika-vallabha* and *Madhu-doota* are two. The names bring into mind the advent of the spring and the first flow of honey.

Mahua goes by the names of *Gur-puspa, Madhu-puspa, Madhu-srava.* The names signify their close relation with honey. The big red flowers of *Semal* (Silk-cotton tree) yield nectar profusely. Flowers of soap-nut tree (the dried fruits of which make soap-like lather in water) yield nectar. As a honey-plant it is of great importance in the Kangra Valley in the Punjab. There is a reference of soap-nut honey in Watt's "Commercial Products of India". Clover yields nectar and pollen both, a detailed note on which will be found at the end of this Chapter (page 207).

The list above is not exhaustive. And there are lots of wild nectariferous plants and trees. The bee-keeper should also know that a good honey-yielding plant of one locality may not be so yielding in another area, and even may not yield at all. He should have a thorough knowledge of the bee-plants in his locality, as also their blooming time.

Flight Range of Bees :—Bees fly in all directions from the apiary for pollen and nectar. Their sense of smell is very keen and they can easily detect an area in bloom by the odour. Colour also attracts them from a long distance. Bees have their own

taste and they are very fastidious. For example, at Sodepur bees collect nectar from mango blossoms, but a bee-keeper friend in a certain North Bengal district says that his bees do not visit these blossoms though there are plenty of mango trees in and about his apiary. This may be due to the fact that when mango trees blossom there, the bees get a different nectar from another source and they prefer the latter.

The range of flight of the bees depends on the distance between the apiary and the bee-pasture. They may fly about two miles and even more in quest of food. But the most effective range, so far as the storage of surplus honey is concerned, is about half a mile. Bees try to find out nectar and pollen as close to the apiary as possible, and by nature they will not go far away if they get a supply near-by. They gradually increase their range as the supply near at hand diminishes and exhausts. It has been found that the bees will go straight to a blooming plot 150 feet away from the yard, but an equally blooming plot of the same flowers 350 feet away in another direction, will be left practically untouched. It must be understood that less the foraging distance, the better is the yield of honey.

Time of Visit :—Much depends upon the plant and the secretion of nectar. Bees are busy throughout the day in visiting flowers as will be evident from a look at the hive-entrance at any time from morning till evening. But generally they are most active in the morning and then in the afternoon than during the other parts of the day.

The Honey Flow :—Bees gather nectar, more or less, throughout the year for their consumption. But the main flow occurs either in the spring or in autumn when surplus honey is available. And this secretion of nectar during the season is termed by the bee-keepers as the *honey flow*. But we know that it is not the honey but nectar that is secreted and carried to the hive. And it is most important that the bee-keeper should be familiar with the local bee-pastures and the main blossoming time so that he may avail himself of the flow to its fullest capacity.

In the Plains the main flow occurs in the spring. There may not be a flow for one long continued period. It may come as a succession of flows with an interval of a few days or weeks according to the different plants flowering during the season.

Generally, we get the first flow by the first week of February, but it is consumed by the bees for comb-building and brood-rearing. The actual storage in the super begins by the third week of February. The super must, therefore, be kept ready before that. The flow diminishes by the last week of March.

A second flow begins by the end of the first week of April and practically closes by the third week of the month. Yet a third flow is available by the first week of May if there be no rains. It continues till the end of the third week of the month when the spring flow finally ceases. This third or the last flow as it may be called, gives very thick honey, darker in colour, the smell and the taste of which are inferior.

The first flow yields honey of lighter colour having a very fine mild aroma. It is sweet, delicious and palatable. The colour deepens as the season advances, and the odour becomes strong. A flow of minor importance may be available in November in the Plains, and as has already been said, it may or may not give any surplus to the bee-keeper.

Mr. John Dasiah in his "Hand Book on Bee Culture", writes about the flow season in Travancore and Mysore thus,—"Honey flow season in Travancore, comes off in January 15th and lasts till May 15th and again from October to December; in Mysore from March to May and from September to October. This season depends upon the monsoon in every District."

In the Hills the main flow in autumn occurs in September—October in some places, and in some others in October—November. The spring flow occurs during March—April in some areas, while in some other areas during April—May.

Whether in the Plains or in the Hills, it must be noted that the season and the period of flow vary according to the climatic conditions and the available pasturage. And one should know further that in some years the crop of honey may be highly satisfactory, while in others it may be poor as, we all know, happens generally with the field and other crops.

Honeydew Honey:—Reference to '*honeydew*' honey has been made in Chapter-4 while dealing with the 'Classification of Bees in Old Days' and '*Dal-madhu*' (page 35). This honeydew honey is a substance quite

different from the floral honey. It is a sugary secretion from the leaves of various plants and trees under favourable weather conditions. Bees gather it when the nectar is not abundant.

Early in the spring mango-trees push forth new shoots when they are not blooming. The shining and velvety fresh leaves of these shoots having a reddish tint and just verging on to light green colour, often exude on the upper side a thick syrupy fluid of brown colour like molasses. It is sweet and tastes slightly acid on the tongue. On several occasions the author had seen the bees gathering this fluid from leaves shooting forth from some of the mango-trees in the month of May when nectar was not coming in. Honeydew attracts ants and other insects also.

Reference is found of a "sweet glutinous liquid" excretion, on the underside of the leaves, which is of insect origin, and sometimes gathered by the bees in Europe and America to the annoyance of the bee-keeper. But we have not seen such excretions being gathered by the bees here.

Clover :—White clover is a most important source from which nectar is gathered in England and America, and it is claimed that it gives one of the finest of all honeys, the colour of which is white. A reference will be found about the "fragrant clover" getting brown, in Chapter - 32, in connection with the old methods practised in England and America in keeping bees and extracting honey.

In America the sweet clover was first considered as a "noxious weed", and some people even felt that

its spread should be restrained by law, and in fact laws and ordinances were passed requiring farmers and others to mow it down along the roadsides. There had been a lot of discussion for years regarding sweet clover. It came to stay ultimately and is now grown extensively and considered a valuable plant as a forage for cattle and horses, and as such it serves as a bee-pasture as well.

It is said that no other pasture is quite as good and safe for cattle to graze upon. It is claimed that growing of sweet clover is the best possible way to prepare the ground for the successful growing of Alfalfa, and that it improves weak soil by fixing nitrogen in it. The sweet clover thrives best on soil that contains lime most.

Some time back a kind friend and a lover of bees presented us with a book on clover which he had got while in America. The first four pages of the book are missing including the title-page, and nowhere inside it is the name printed. Page five begins with "Instructions for Sweet-Clover Growing" by Frank Coverdale. And in page ten is the "Introductory to First Edition", by A. I. Root, dated May 1, 1910. Page twelve begins with the "Testimonials from all over the World in Regard to the Value of the Sweet-clover Plant," which continue upto page 108 and where the first part of the book ends. Its Part II "consists principally of clippings from our journal, 'Gleanings in Bee Culture', from July, 1910, up to September, 1913". This 'our journal' shows that it is a publication of The A.I. Root Company. In the

book, which appears to be an old publication, the reader will find much information on American sweet clover.

The place of white clover has been taken by red clover and Alsike or Swedish clover. And it is now stated that alsike clover yields nectar more freely and is a more reliable honey-plant than white clover. It should be noted that sweet clover is the principal honey-plant in the United States.

Clovers in India :— There are two varieties of clovers in India. One known as *Berseem* has white flowers, and the other *Shaftal* has flowers of pink colour. Of the two, the *Berseem* is considered to be better. The growth of the plant and the supply of nectar and pollen depend on the nature of the soil, irrigation and climatic conditions. For some time past we have been trying clovers at Sodepur as an experiment, but not with much success.

In the N. W. Frontier Province, clovers are grown in abundance for fodder and seed. In the Kulu Valley (Punjab), white clovers grow wild in the pastures and along the water courses. It starts blooming by about the middle of March, but it is not until after some weeks that the full bloom is on. It remains in flower upto September. Bees in some of the areas visit the flowers eagerly for nectar and pollen at certain times of the blooming period.

The importance of clover as a honey-plant will be well understood from the facts as stated above. And it is worth-while for the bee-keepers in India to try it in their own areas and study the results.

CHAPTER XVI

EXTRACTION OF HONEY

Honey cells are sealed by the bees when the honey is ripe. Such honey when extracted and stored will not ferment. Combs containing uncapped and thin honey should be left in the hive for maturing. (For details, see page 191, under 'Supering').

The honey is to be extracted with the help of the honey extractor the first of which was made in 1865 by an army-officer named von Hruschka in Venice. It was subsequently improved upon. (For Honey Extractor, see page 99). The honey extractor is an indispensable appliance when any amount of regular work is to be done. (For extracting a few combs occasionally, see 'Extracting Honey without an Extractor', Chapter - 37).

For the extraction of honey, remove those combs from the hive that are to be extracted, and place them in an empty brood chamber close by ; while doing so, examine the combs carefully and see that the queen is not there. This precaution is needed so that the queen may not be inadvertently shaken off along with the bees while they are being removed from the combs. If there are empty combs to be replaced, then interpose them first between the combs that are already removed for extraction so that some

of the bees may go over to these empty combs, and thus relieve the congestion to some extent. Examine the brood combs next, and do whatever is needful; then close them up. Now, take out the empty combs that were in the extra brood chamber and arrange them in the super, and close the hive.

Bees will be found thickly covering the shallow combs in the super as also the deep combs in the brood chamber. At the height of the season the Newton hives may have between twenty-five to thirty thousand bees, and the British standard-frame hives, between fifty to seventy-thousand of them. One shall have to shake off quite a good number of bees in order to free the combs for extraction. Now, shake the bees off from the combs one after another and remove thém to the extracting-room, and place them on a frame-stand. (Frame Stand – Fig. 39).

Uncapping the Combs :—For uncapping, take a frame and hold it by one of its shoulders in the left hand vertically. Place the other shoulder on a piece of batten, $1'' \times \frac{1}{2}''$ and 18″ long, laid over the uncapping tray. (Uncapping Tray—Fig. 52). Hold the frame with the top-bar facing the operator or as convenient. Tilt the comb slightly towards the left. Pass the uncapping knife just underneath the caps. (Uncapping Knife—Fig. 51). Starting from the bottom, draw the knife evenly upwards and shave off the cappings with a little backward and forward motion of the knife. Uncap both the sides thus. While paring off the cappings, cut straight all the uneven and bulged-out portions of the comb.

It is convenient to use a pair of knives instead of a single knife. Keep them standing in a jug of hot water and change the knives alternately as they cool down. See that the knife-edges are sharp. A hot blade will pare off the cappings easily and also cut clean. Bits of cappings and honey-drippings from the knife-blade should be scraped on the edge of the tray from time to time. Uncap the combs thus. For a long-continued work, it would be better to keep the water-jug on a wick-stove burning slowly.

Working the Extractor :—Place the extractor on a stand in the extracting-room, and place the legs of the stand in cups of water to avoid ants. As a makeshift arrangement the extractor may be placed on an empty packing case or any other raised surface. The stand should be sufficiently high so that the honey can be easily drawn off into a vessel from the tap at the bottom of the extractor. Place two combs, nearly of equal weight, in the cage of the extractor, one opposite the other. Four shallow combs may also be worked at a time. Perfect balancing of the combs in the cage is important, as otherwise the extractor will shake violently on turning the handle and make the extraction difficult. Frames should be so placed in the cage that while rotating, the bottom-bars may go forward first.

Rotate the cage slowly at first, by turning the handle, and then slightly increase the speed. By working a few pairs of combs, one will get an idea as to the speed and the number of turns necessary for proper extraction without injuring the combs.

Beginning with some speed and after a few turns, the combs may be raised to see how far the extraction has advanced, and the speed and rotation may thus be regulated. When one side of the comb has been extracted, stop the cage, reverse the frames and extract the other side. Return the empty combs to the hive if their places have not already been filled with other sets of empty combs at the time of their removal.

Keeping Record of Yield :—In order to keep a record of the yield of every hive, weigh the combs of each hive separately in a spring balance after they are uncapped, but before being extracted. Next, weigh the combs after extraction, and thus get the weight of the extracted honey.

Draining Out the Honey :—Drain out the honey from the extractor into a suitable vessel through a funnel covered with a piece of clean cloth so that the small pieces of cappings or bits of combs may be held back. Keep the vessel containing the honey properly closed. Honey is highly hygroscopic. It will absorb moisture from the air if the container be not kept properly closed.

Protection Against Breaking the Comb :—The cage should be rotated carefully so that the combs, though wired, may not break due to the excessive speed of rotation. When a comb is full and heavy, extract about half the honey from one side of each comb first, then reverse the combs and extract the other side fully, after which expose the first side again and extract the remaining half of the honey.

Honey From the Cappings :—The cappings contain a small quantity of honey, and when several combs are to be extracted at a time, the quantity may not be negligible. If the uncapping tray does not contain the second tray made of wire-netting, then spread out the cappings on a piece of wire-net and place the same on the tray. The honey will be found to have been drained out. The honey that would still adhere to the cappings may be squeezed out and given to the bees. The small balls of cappings that will now be got after squeezing out the honey should be stored in a covered tin-can for the present, and the wax extracted out of it later on conveniently.

The Extracting-room :—Extraction should be done in a well-lighted, well-ventilated bee-proof room having self-closing doors. The windows should be fitted with wire-nettings. The ceiling should be well-covered. The sweet odour of the honey attracts the bees during the extraction. They will make the work impossible if they get any access into the room or if they can approach the combs somehow. Where a lot of combs are to be extracted daily, the extracting-room is indispensable. A makeshift arrangement can be made where only a few combs are to be extracted, by setting a clean mosquito-curtain in a room as is ordinarily used for a double bed, and work inside it. If this latter arrangement also be not possibe, then at best the honey should be extracted at night.

The appliances should be clean. The utensils, the table, the room and the floor should all be clean.

It should always be remembered that honey is a food and will be used for human consumption. Cleanliness should be religiously observed. Honey must not drip out and soil the floor. Drippings on the table should be wiped out with a clean wet rag. Water should be provided in the extracting-room. It may be kept in a bucket. A water-tap in the room near the working table with proper arrangement for drainage, will be good.

The Super Clearer :—It has already been said that the bees shall have to be removed from the shallow combs before they are taken to the extracting-room. Removing the bees by shaking them off as has been described, would require less than half a minute per comb. The task is not difficult and the process is easy.

The hill-type bees may be made to move away from the comb simply by rapping the frame with the knuckle or the knife-blade. They will be bewildered and frightened by such rapping, and if in that state one end of the shoulder of the frame be raised up and allowed to rest on the alighting board in a slanting position, the bees will leave the comb and enter the hive. (See page 185).

But the super can also be cleared of the bees by the use of 'Porter' *Bee-escape*. The bee-escape consists of a tin box like the outer-casing of a match box, but only ¼″ high, with two pairs of very delicate flat springs, fitted at the two open ends lengthwise. The open ends of the springs are curved and very nearly touch each other. On one side of the box is

a round hole in the centre, 1″ in diameter (Fig. 68). The bee-escape is fitted in the centre of a wooden board large enough to cover entirely the top of the brood chamber, thus making a *super-clearer*. It provides one way escape from the super to the brood chamber. At one end of the board is a hole, $1\frac{1}{2}''$ in diameter, which may be opened or closed by a cover specially arranged.

The super-clearer is placed between the super and the brood chamber. Bees can only go down from the super to the lower chamber by pushing themselves

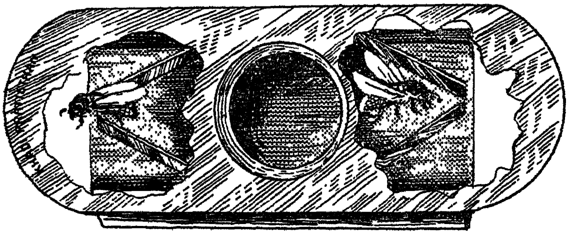


Fig. 68. Bee Escape.

through the springs of the bee-escape, but cannot have access from the lower chamber to the upper. The bees can have direct communication between the chambers if the side-hole of the super-clearer be opened by removing the cover.

In order to clear off the bees, the super is gently raised in the evening and the super-clearer is placed underneath it. Next morning if the super be found cleared, the bees having entered the brood chamber, the combs will be ready for removal for their extraction.

The super-clearer can also be used for cleaning up the extracted combs when desired. In that case the side-hole is opened. The bees come up and dry the combs by sucking out every trace of honey. The bees can then be made to clear out through the bee-escape by closing the side-hole.

But in removing the bees, the method of shaking them off can be safely relied upon. And for drying up the extracted wet combs after the honey-flow season, they may as well be left in the supers overnight, removed in the next morning and the few adhering bees shaken off, and then the combs stored for future use.

CHAPTER XVII

THE HONEY YIELD

Several things shall have to be considered if one is to get a satisfactory yield of honey. The conditions that help to bring about a good harvest of honey have been dealt with exhaustively while discussing matters on comb-building and raising the population, pasturage and flight range of bees, sources of honey, weather and climatic conditions, the honey flow, and the swarming and its effect on the collection of surplus honey. But above all it must be said that everything centres round the man who will work.

Personal Element :—Under favourable conditions and having everything in order, the greatest success in the production of honey depends on the man on the spot. Application of knowledge to actual work depends on the patience, confidence and the aptitude of the bee-keeper. After all, the bees are wild tiny insects, domesticated artificially by human intelligence and made to yield a good surplus of honey by the effort of the bee-keeper. It is, therefore, that the personal element counts. The more the experience, the better will the bees be amenable, and the more the attention paid the better will be the yield. It may generally be said that one would take at least

three honey-seasons to come to his full experience in managing the thing to his complete satisfaction.

Yield per Comb :—That depends on the extent to which the comb has been built, and to the extent to which honey has been stored. A maximum yield of fourteen ounces of honey was received by us from a $2\frac{1}{2}''$ shallow-comb of the Newton hive. The deep Newton combs yield between twelve to twenty ounces. A maximum yield of 2 lbs. and 6 ounces of honey was received by us from a comb of British standard size.

Yield per Hive :—The average yield of honey varies from place to place, and from year to year. For starting an apiary a suitable position has got to be selected. But in cities and towns where bees are kept, it may not always be possible for the bee-keeper to select as desirable a position as he would wish. For, the space at his command may be limited, and he is to get on as best as he can. In large cities it may not be possible for the bee-keeper to get any big yield. But he is sure to find the occupation highly fascinating and should be satisfied with as much surplus honey as his bees will be pleased to present him with.

Bees are kept in Allahabad, New Delhi, Lahore and in other cities and towns. Bees are kept in the city of Calcutta. And before we proceed to record the yield of honey per hive here and there in some of the places in India, we would take Calcutta first, just to acquaint the readers how bees are kept there.

(1) Dr. Ramapati Mukherji, M. B., D. T. M., keeps bees at 10, Preonath Bannerjee Street, Calcutta.

His two hives are placed in his bed room, beside the windows.

Mr. J. H. Methold is a member of the Legislative Assembly, Bengal, and a Councillor of the Municipal Corporation of Calcutta. He keeps bees at 6, Dover Park, Ballygunj, Calcutta. He has two colonies and the hives are placed in his garden, suitably protected from sun and rain. From one of the colonies he extracted about two pounds of honey in the spring of 1944. That was the first honey season that he could avail himself of after he started keeping bees.

Mr. Sannyasi Charan De keeps bees at 22, Paikpara Row, Calcutta. He started by capturing wild colonies. Early in the spring of 1944, he had three colonies from one of which he got five pounds of honey in two extractions. He had to be away sometime while the flow was on, and by the time he came back, the flow was practically over. He divided a colony and increased the number. He has four colonies now, one of which is placed in a bower in the yard and the other three are in the roof, properly protected.

Mr. Amarendra Chandra Gooptu keeps bees at 87, Rashbehari Avenue, Calcutta. In the first flow season in March - April last, he extracted four pounds of honey from the two colonies he had then. He has now seven colonies. The hives are kept under the bowers in the garden in front of his house, protected from sun and rain by double-walled wooden cases specially made by him with galvanised iron-sheet coverings for each, to drain off water.

(2) Kestopur is a village about five miles from Shyambazar (North Calcutta), on the Kestopur Canal. Mr. Krishnapada Banerjee keeps bees here. In the first flow season (1944) that he could avail of, he had an average of 7 lbs. of honey per hive. He started with bees captured locally.

(3) Sodepur is ten miles from Calcutta on the B & A Railway, main line. The Sodepur Apiary is adjacent to the Sodepur railway station, and situated within the Khadi Pratisthan compound. Here the average yield from the local Plains type of bees in 7-frame Newton hives, varies between 10 to 13 lbs. per year, while a maximum of 25 lbs. was obtained from a single colony. A maximum yield of 40½ lbs. of honey was obtained from a single British standard hive of eleven frames.

In 1942, the average yield from the local bees in Newton hives was 13 lbs. The British standard-frame hives also yielded 13 lbs. on an average. In 1943, the average yield from Newton hives was 10 lbs. and 3 ounces, while the average from the British standard hives was only 8 lbs. The flow this year was poor, and the result was that though the Newton hives maintained their average yield to some extent, the yield from the Standard hives went down abnormally. (See page 80). In 1944, the average yield from Newton hives was 13 lbs., while the average from the Standard hives was 17 lbs. All these are from the local bees of the Plains type.

With the Hill-type of bees, the average yield from Newton hives in 1944, was 20 lbs. and 9 ounces.

It is to be noted that we experience difficulty in acclimatising the Hill-type of bees here, and replenish stock whenever required.

(4) Mr. Tarapada Sen owns the Maheshpur Apiary near Chinsurah in Hooghly district (Bengal). He is an educated agriculturist, and keeps bees as a side-line to farming. He uses Newton hives of 9-frame capacity. His average yield per hive per year is about 13 lbs. A maximum yield of 25 lbs. of honey from a single colony was obtained by him.

(5) At Sagarpur off Pandaul, district Darbhanga (Bihar), the Khadi Pratisthan has an apiary under the charge of Mr. Shivanarayan Mishra. Here the average yield from Newton hives is about 14 lbs. per year.

(6) At Bari in Cuttack (Orissa), the 7-frame Newton hives are in use. The average yield is 10 - 12 lbs. A maximum yield of 45 lbs. was obtained from a single colony here.

(7) At the apiary attached to the Entomological Section of the Agricultural College, Coimbatore (Madras), an average yield of $10\frac{3}{4}$ lbs. was received. The figure represents only their first year's average beginning from October 1932 to July 1933. Cambodia cotton crop was the main source of the supply of nectar.—(Bulletin No. 37, Department of Agriculture, Madras). It may be stated that the Newton hive is in use here.

(8) At Wardha in the C. P., a colony produces between 12 to 15 lbs. of honey per year. —("Bee Keeping" by Mr. S. M. Chitre, 1939, published by A. I. V. I. A., Wardha).

(9) Mr. John Dasiah, Secretary to the Y. M. C. A. Rural Demonstration Centre, Martandam, Travancore, writes in his "Hand Book on Bee Culture", 1938, that a minimum of 15 lbs. of honey was obtained per year from each colony of bees. It may be mentioned that the Martandam Y. M. C. A. Rural Demonstration Centre after repeated experiments has found that the Newton hive is best suited there.

(10) Mr. T. V. Subramaniam in his booklet named "Bee-keeping for Beginners" (Revised Bulletin No. 10 of the Entomological Series, 1938, Department of Agriculture, Mysore State), writes that under favourable conditions 20 lbs. of honey per hive per year may be obtained from strong colonies in a good locality.

(11) At Coonoor (Nilgiri) the average yield from Newton hives is about 10 lbs of honey per year.

(12) At the Jeolikote Apiary, Jeolikote, district Naini Tal, U.P., the maximum yield from a single hive in 1942 was 82 lbs., and the average production of honey for the year came to 22·5 lbs. per hive. —(I. B. Journal, 1942, page 61).

(13) In an article published in the I. B. Journal (1944, pages 48-51), the Entomologist to the Punjab Agricultural College, Lyallpur, gives a detailed account of honey-yield in the Punjab. We find that at the Government Bee-farm at Nagrota (altitude 3,000 ft.) situated in the low hills of the Kangra Valley in the Kangra district, an average yield of 16 lbs. per colony was obtained in 1938; the maximum yield from a single colony was 42¼ lbs. It was an average honey-year.

Then in 1942, the average yield was 21 lbs. and 2 ounces, while the maximum yield from a single colony was 56 lbs. and 5 ounces. Honey flow was good this year. And in 1943, the average yield was 8 lbs. and 10 ounces, while the maximum yield from a single colony was 24 lbs. and 14 ounces, the April flow having totally failed this year.

At the Government Bee-farm at Katrain (altitude 5,000 ft.) in the Kulu Valley, district Kangra, an average of 8 lbs. and 5 ounces was got in 1938, the maximum yield from a single colony that year was 25 lbs. In 1941, the average yield was 27¾ lbs. while the maximum from a single colony was 76¾ lbs. There was a good rain this year and the flow was good. And in 1942, the average yield was 28½ lbs., while a maximum yield of 97 lbs. was received from a single colony. The flow was unusually good this year.

The average yields of honey in the Experimental Apiary at the Punjab Agricultural College, Lyallpur, for three years 1940-41, '42, and '43 were 11 lbs., 19 lbs.-7 ounces, and 13 lbs.-1 ounce respectively per colony, while maximum yields of 25 lbs., 51 lbs. and 60½ lbs. were recorded for those three years from individual colonies. Lyallpur is 600 feet above the sea level, and it is considered that it has the typical climate of the Punjab Plains.

(14) Lastly, we come to the N. W. F. Province. Here Mr. R.C. Talwar of the Hazara Apiaries, Haripur, in 1942, got an average yield of 33½ lbs. of honey per hive per colony, while the maximum yield from a single colony was 67 lbs.—(I.B.J. 1942, page 109).

Improve the Strain :— There is a general belief that the Indian Bee is not a good honey gatherer and, therefore, only a small quantity of honey can be harvested from a colony. In the face of the traditional low output of the Indian Bee, the honey yields as shown above should be an eye-opener. Improvement of the local strain of bees by eradicating the undesirable characteristics and increasing the breeding qualities of the queens are the things that should draw the attention of the bee-keepers. Apart from the flow of nectar, the collection of surplus honey depends on the working qualities of the foragers, for, it has been found that when nectar is available equally to all the colonies in an apiary and when the colonies are equally strong, there is a variation in the amount of surplus honey. Thus the qualities of the workers determine the value of the stock. And the worker represents half of the queen and half of the drone. Systematic breeding for the production of better queens is necessary in order to increase the economic value of the bees. And that demands both time and labour on the part of individual bee-keepers. Bee-keeping is a comparatively new industry in India. Provincial Governments can foster the industry by starting experimental bee-farms and rearing better queens for the use of the local bee-keepers.

Yield in Other Countries :—The average production of honey per hive per year in U. S. A. is about 35 lbs. In England it comes near about the same figure. Yields like these are highly satisfactory, indeed. (See 'European Hive-Bee' in Chapter - 30).

The European Bee and Diseases :—The European bees fascinate many of us on account of their better yield of honey. But it is a fascination for the unknown. Bee-keepers have tried here and there in India with Italian bees, but the reports so far received are not encouraging. Apis Mellifica, it seems, does not thrive well in the Indian climate, and there are also other difficulties regarding this bee. Apart from the various desirable qualities of the bees for the better production of honey, they require to be healthy and free from diseases. Diseases are ruinous to the bee-keeper.

The European bees suffer from various diseases which affect both the brood and the adult bees. (See page 67). There are remedies, of course. The safest treatment of bees suffering from certain infectious diseases is to burn all the combs and bees. Persons working in the affected apiary are to take precautions against the spreading of disease to other colonies in the apiary, and from one apiary to another. Why then, moved by the lure of better yield, when even the rudimentary knowledge of keeping bees under modern methods is wanting to-day and when there are not enough bee-keepers in the country, bring in the foreign bee-disease and risk the Indian-bees which are free from diseases ?

There are various causes of ailments affecting the bee-colonies. Prevention and treatment are possible only through proper investigation and research work. But where is the equipment and knowledge for such work in India to-day ? It is beyond the range of the

Indian bee-keepers, circumstanced as they are at the present moment, to cope with the European bee-diseases and the further complications that may arise therefrom.

Keep 'Indian Bee' :— Behind the success of the bee-keepers in England, America and other countries stand their resolute will and research work. Let that enthuse the Indian bee-keepers to carry on with the indigenous Indian Bee. In spite of the ravages of moths and such other natural enemies, and in spite of the depredations and reckless killing of bees by the bee-hunters year in and year out for ages, the Indian-bee colonies exist in abundance throughout India. They have withstood the severe test of time. Diseases are unknown to them. It is for the bee-keepers here to improve by selective breeding the Indian Bee, the bee of the land, and get satisfactory yields. The technical knowledge combined with the knowledge of the economics of the industry can bring the much-desired success.

CHAPTER XVIII

STRAINING AND BLENDING HONEY

Honey as received from the extractor, has to go through certain processes for improving its condition and appearance before it can be bottled and canned ready for the market. (For 'Storage and Retail Package of Honey', see Chapter - 27).

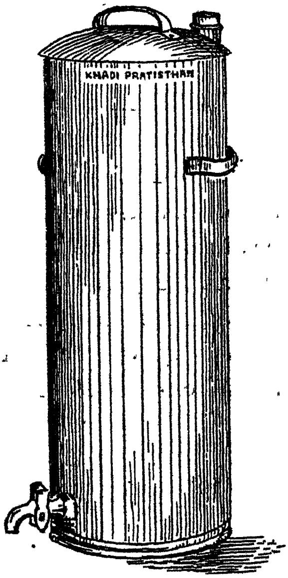


Fig. 69. Bottling Can.

Straining and Settling Honey :— Honey can be drained out from the extractor, as has already been said, into a suitable vessel through a funnel covered with a piece of cloth, so that bits of cappings and any other foreign matter may be separated from it. (See page 213). It should then be finally stored in a tall cylindrical vessel for settling, having a tap at the bottom so that honey may be drawn off when required (Fig. 69). A can 9" in diameter and 24" high, will hold about 56 lbs. of honey.

Honey can as well be strained with the aid of an appliance called "Honey Ripener" (Fig. 70) which is

a tall vessel having a coarse wire sieve at the top and a straining cloth tied round the sieve at the lower end so that the honey may ultimately run into the vessel being strained through it. Honey should be allowed to remain in such vessels for some time in a comparatively warm room for settling before being drawn off. The 'honey-ripener' does not ripen the honey, but it only helps in straining and settling.

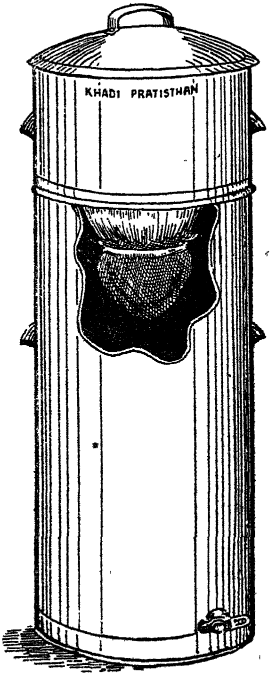


Fig. 70. Honey Ripener.

Honey is filled with minute air bubbles during the process of extraction when it is thrown out of the comb. It is, therefore, that the strained honey should be allowed to settle in the vessel so that it may be cleared of these bubbles. Honey being very viscid, it requires time for the bubbles to rise to the surface. They form a scum at the top along with the thin honey. For clearing of the bubbles, the honey should be allowed to settle for about 48 hours before being drawn off.

Blending Honey :—The colour of honey ranges from glistening white to deep red according to the season and the kind of flower from which nectar has been

collected. The flavour and aroma also vary between different extractions. Consumers may unwittingly become suspicious of the genuineness of honey if between the supplies they get different colours and different aromas. From this stand-point it is desirable that honey should be blended to have one uniform colour and flavour.

Heating Honey :—The heating of honey is forbidden in the Ayurveda. It is better not to take recourse to this. But occasions arise when one has to do it. Granulated honey requires heating to bring it to its original liquid state. The honey may sometimes have to be heated to drive off an aroma which is not so very pleasant. Thick honey may have to be heated for thinning down. For all these, a mild heat is necessary, and it is best done by placing the container in hot water-bath. The honey should never be heated over direct fire.

Unripe honey requires heating to prevent fermentation. And then, the fermented honey requires heating to stop further fermentation. For these purposes the honey should be heated in water-bath, keeping the temperature of the bath constant at about 150° F. The temperature of the honey must never rise above 130° F. Heating the honey thus for 15 to 30 minutes may be considered enough, but it depends on the extent to which it is unripe or has fermented. Air bubbles will be produced on heating the honey. The bubbles will form a thin or thick layer on the surface which should be removed to expose the honey.

To whatever extent one may restrict the time and temperature in heating, the honey will lose its original colour and its transparency to some extent, and will be deprived of much of its aroma. Heat drives off the volatile oils and darkens the colour of the honey. And if the honey be kept at a high temperature for a long time, it will have a smell of burnt sugar. Honey, therefore, should never be overheated.

The honey, three-fourths of which is ripe, may be packed in tins and placed under the direct rays of the sun with its cap open, but covered with a piece of cloth. It should be removed in the afternoon and the cap closed. This may be continued for a week for the full ripening of the honey instead of heating it in water-bath. Well-ripe honey need not be heated.

Honey filled in wide-mouthed bottles when placed under a bell-jar in the sun for four hours in the month of April, with the mouths kept open, showed appreciable change of colour. A straw-coloured honey changed to blackish light-brown when thus heated for three days.

Density :—The keeping quality of honey depends largely on its water-content, for, honey will not keep unless it is sufficiently ripened. The honey containing more than 20 to 25% of water may be considered as unripe. The specific gravity of honey should not be lower than 1·415, as otherwise it will lose its flavour and the clear appearance on account of fermentation.

CHAPTER XIX

ROBBING AND FIGHTING

Robber bees would be seen loitering about the entrance of the hive hesitatingly. Their very thievish manner of approaching a hive would mark them out. It is not difficult to find out at a glance from among so many bees busy at the entrance in their daily work, the one which is a robber. They circle round the hive and fly near the hive-door very cautiously with a peculiar sharp humming. Their hesitating mood seem to show that they are probing whether or not there is any resistance, and if so, to what the extent of it might be. The tendency to rob is there, and they seek an opportunity. They will try at the door of every colony in the apiary, and find out the weakest one.

When the nectar is coming in plentifully, there will be no robbing ; the bees will take no notice if one of another colony enters the hive by mistake ; rather they will allow it to go in and store the load. But it will be a different thing in the slack season when the nectar is scarce. We find that when after the main flow is over in the spring, and rains set in, and the bees cannot go out as freely as they would like, typically at this time when the nectar is scarce and during the winter months when nectar is scarce too, robber bees knock at every door to get honey by robbing. After an incessant rain for days together when there is

sunshine, the robbers will be about invariably, and their peculiar sharp hum makes the bee-keeper uneasy; his legs, without the least thought, would carry him to those hives which are weak, to see if there is anything wrong.

It is exceedingly difficult to bring the robbers under control when once the passion for replenishing their stores by robbing is roused. It is generally the weak stocks that fall as a prey. If the bees of the hive resist, the robbers become violent and furious. The author had seen robbers swooping on the resisting bees in an attacking mood and thrusting their stings in anger.

Signs of robbing are clear. Robbers fly about the hive and try their utmost to enter through all the chinks, joints and ventilators. There is excitement at the entrance of the hive robbed, and there is commotion within. The bees try to resist, and the fight begins on the alighting board. Couples of bees entangle themselves in death grip, roll, whirl about and fall on the ground. Some will be found injured, and some dead. Hundreds die in this way. This happens when the confirmed robbers try to force their entrance into a hive and the resistance is stiff. The bees will resist for some time, but they are sure to succumb ultimately if the colony be weak. It should be noted that the Hill-type of bees offer determined resistance to robbers in all circumstances and deliberately give their lives to save the colony.

There is no greater nuisance in an apiary than this robbing. The whole apiary becomes excited in

no time. The loud tumultuous noise can be heard from a distance. When once robbing is started, the colonies that have enough food, sometimes turn mad and the bees behave as robbers. When once a weak colony is robbed, there is every likelihood of similar colonies being attacked.

One must not mistake robbing with the usual activities of the workers when they are busily engaged in bringing nectar and are in a hurry, or with their play flight. When robbing has continued for some time, the activities of the robbers may, to some extent, look like a play flight, but the abdomen of the robbers coming out of the hive will be found to be highly distended. Heavy with the full load of honey they find it rather difficult to fly away as quickly and easily as they should have done if the abdomen had been empty. The abdomen of the robber bee with the full load of honey looks somewhat translucent, and the stripes also become very prominent due to distension.

The bees of wild colonies in the neighbourhood sometimes come in large numbers and carry on the nefarious work. They sometimes abandon their own hives on account of starvation or due to the ravages of wax-moth caterpillars, swarm out, enter the apiary in order to find suitable shelter. The bee atmosphere attracts them. They whirl round the apiary, and ultimately select a hive, and try to force their way in. If resisted and baffled, they sometimes cluster at the top-ventilator. The queen of the swarm on alighting runs the risk of being 'balled', maimed and

killed. (See 'Balling of Queen' below). The swarm becoming queenless will take wing and try to find their way into different hives. The swarm may be captured and hived if, instead of attempting to rush in, it clusters at a convenient place outside. But the bees shall have to be fed, and artificial feeding may again excite robbing, and it would be difficult then to save it.

The robbers carry away the stores. They destroy the combs, the grubs and eggs, and leave the colony to starve. In case of a severe attack like this, the bees sometimes decamp on account of fright and disturbance.

Remedy :—When robbing has started, the remedy lies to some extent in contracting the hive-entrance to one or two-bee space, in putting obstacles at the entrance by throwing some straw, hay or green grass and sprinkling some water on it. In order to obstruct direct entrance into the hive, a small piece of wood about the size of $4'' \times 1\frac{1}{2}'' \times \frac{1}{2}''$ may be placed against the contracted door in a slanting position so that there may be opening at the two sides only; the robbers will be obstructed thereby and the bees of the hive will be in a better position to resist them from behind the shelter given by that obstruction-piece of wood. Water should be sprayed on the robbers as they cluster near the entrance and try to force in. Having done all these, wait and see the effect.

If the above methods fail, then open the bottom-board ventilator, and close down the entrance completely. In the absence of the bottom-board

ventitator, the entrance and exit of the bees can be stopped by placing a wire-gauze against the entrance after widening it to some extent; this will have the desired effect without impairing ventilation; the widening of the entrance is necessary because the robbers inside the hive will press hard against the wire-gauze to come out, and if there be only a two-bee entrance, the ventilation may be obstructed. After an hour or two, open the door slightly and allow the robbers to escape. Keep watch for some time, and if the robbers come again, then close the door for the day and open it in the evening. Keep a careful eye on the hive the next day from the early morning.

When robbing is going on, try to trace the hive or hives from which the robbers are coming. Hurriedly mark the entrance of all the hives in the apiary and note the activities of the bees. Any unusual activity of the bees of a hive will at once indicate that they are engaged in the wicked work. When the robbers are pushing each other at the entrance of the hive robbed, and when some are coming out of the said hive, or when the door has been shut completely and the robbers are trying to push in, forming a small cluster, dust some talc-powder or flour over them. They will disperse at once. Now, watch the entrance of the suspected hives and see if the bees are entering, smeared with the white powder. If the bees of a particular hive be thus traced to be engaged in robbing, then they must be brought to book; their tendency should be curbed by closing down the hive-entrance for about an hour, after providing proper

ventilation. On opening the entrance, some of the bees will be found to have died as will be evident when the dead bees will be carried away by the workers in cleaning the bottom board. These bees must have died outside while on work, in the usual course. The author had found that the number of such deaths vary between 20 to 100 according to the population of such hives, when he had occasions to close entirely the entrance of some of his hives for about three hours.

Another method of controlling the robbing is to interchange the position of the hives of the robbers and the robbed. But it may not be effective in all cases, for, here again the hive of the robbers now having occupied the stand of the robbed, expose themselves to the same risk of being robbed in turn by the robbers of the other hives. This has been the experience of the author. In order to save a hive when robbing has once commenced, the best course would be to remove it away from the apiary and place it in another quarter, if possible. The author has successfully stopped robbing in this way.

Prevention :—To protect a colony from robbing is to keep it strong. Scarcity of food compels the bees to take to robbing. Therefore it is better to see that the bees have plenty of food and do not suffer from shortage. Artificial feeding helps the starving colony to pull on (see page 168). But it must be noted that once the population has been reduced to a great extent, and when there is no food in the hive, artificial feeding will invite robbing unless the quantity of syrup given to the bees is such that they can

empty the bottle overnight and do not store any surplus. Feeding the bees with a small quantity of syrup every alternate day, or twice or once a week as required, may not excite robbing. The food should be given only in the evening and the feeding bottle removed early next morning. (See pages 154 and 170).

It is difficult to save the weak colonies from the attention of the robbers. Instead of having several weak colonies, it would be better to unite them and thus get stronger ones.

Balling of Queen :—When the bees of the hive robbed have been overpowered, and the hive is in full possession of the robbers, it has sometimes been found by the author that the queen was 'balled' by her own bees.

By 'balling' is meant the encircling of the queen by a lot of bees, pushing and pressing her from all sides. The bees cling together forming a stiff cluster which look like a ball, with the queen inside it. It becomes very difficult then to pull the bees apart.

It is easy to understand the balling of a strange queen on the alighting board or inside the hive, when the virgin queen after her nuptial flight alights on a wrong hive, or when a swarm tries to take shelter in a hive already occupied, as referred to above while writing about the peculiar behaviour of the starving wild bees near about the apiary. But so far as the balling of their own mother is concerned while robbing is going on in the hive, it may only be guessed that the bees somehow connect her with the cause of robbing and being thus annoyed, ball her.

The inevitable result of balling is the death of the queen, either due to suffocation or to fright. If balling be detected early, the queen may be saved without much injury to her, but if late, she will be found in most cases to have been maimed and become useless for the purpose of the hive, or dead.

The method of balling is very peculiar. The author had seen that a queen is first chased by one or two bees and being overtaken she is seized by her legs or wings and pulled, when a few more bees will join, and then in a second or two she is surrounded and closed up by a host of others, and the balling is complete.

For releasing the queen, the ball should be removed with a feather and dropped into a vessel containing water. The bees will at once leave the queen for their own lives, when she can be taken out of the water. Another method is to remove the ball and blow a puff or two of smoke to break it up. Another suggestion is to sprinkle the ball with honey, when the bees will divert their attention to honey and release her. The author has found the first method to be very quick, efficient and easy. It can be done without the slightest loss of time.

For re-introducing the queen, she should first be encaged and then introduced, and released when the bees show no signs of anger. (For 'Encaging the Queen', and 'Introducing the Queen', see Chapter - 24).

CHAPTER XX

MOVING STOCKS

It has already been stated that when a hive is shifted to a new place, the bees on coming out of the hive, circle round it and also fly backward with the head facing the hive, carefully noting its position and other landmarks, and then dart away. It is the position of their home that they mark. On coming back from the field they locate by the landmarks the position of the hive. They find out the particular spot and necessarily the hive which is their home. On approaching the entrance, they recognise the colony-odour and enter. If the hive be shifted to another stand at the back and a new hive be placed on the old stand, the foragers coming from the field will alight on the board of the new hive. If now the combs are transferred one after another from the old occupying hive to the new one in the old position, the particular position of their home remains the same but they now occupy a new hive. The flying bees will come to the old spot, alight on the board and enter the hive. A slight difference in the appearance of the hive-front or colour of the new hive may rouse some suspicion in a few bees only, who on entering the hive may be found to be coming out hurriedly as if to examine something, and being sure of the right spot will re-enter and settle themselves to work.

The hive will acquire in the meantime the colony-odour, the foragers will also be accustomed to the slight change of the appearance of the hive, and the colour-mark, if any.

The hive can be moved at a time to a distance of about 2 feet only, to the right or left and to the front or back, without inconveniencing the bees much. But if the hive be moved 3′ or 4′ away from the original place, the bees on wing on coming back to the old spot, and not finding the hive, will circle round and round, and being exhausted, some will drop down and some may die. They sometimes cluster on the empty stand, if left, or on any convenient support close by.

If for some reason a hive has got to be moved to a distance over 2′, then it can be done by the gradual removal of two feet a day, or in the alternative it should be removed to a place beyond its flight range. The latter method takes away the chance of the foragers returning to the old location. The hive may be kept there for about a fortnight and then brought back to the apiary at the desired spot. The removal of a hive to a distance, either long or short, should be done in the evening when the bees have stopped flying.

A gradual daily removal may be tedious, and when one has to drag a hive for a week to cover a distance of fourteen feet, the work may seem to be boring. The removal of hive far away from the apiary may not be arranged. But this two-fold difficulty can be avoided by removing the hive to a new environment about 300 feet away. It then becomes a question of making the

bees understand that they are in a new surrounding, so that they may take note of the changed landmarks, and come back from the field to the new location without difficulty.

For the above, remove the hive to the new position about three-hundred feet away in the evening; contract the hive-entrance to some extent and place a piece of wood about the size of $4'' \times 1\frac{1}{2}'' \times \frac{1}{2}''$ on the door in a slanting position so that the bees may escape only through the openings at the two sides; place another piece of wood of the same size on the alighting board, in the front of the door pressing the former one. These two pieces of wood by obstructing the direct flight of the bees from the entrance, will draw their attention while coming out in the next morning, and starting from the alighting board they will be forced to observe the change in the surroundings, notice the new landmarks and return safe to the hive. In order to draw the further attention of the bees, a rod about three feet long may be pitched on the ground in front of the hive and an earthen pitcher, or a broken tin canister mounted on it, so that the bees may notice this extra mark. Some straw wound round the rod will also serve the same purpose.

Some of the old workers are sure to be misled to the old position following the old track. But that can be ignored. If there are other hives near-by, then they may take shelter in one or more of them, and if not, a small cluster will be found on a stand, or on a pole or any other support near the old spot where they will take rest, being exhausted. These

bees should be brought back to the hive in a net and dumped on the alighting board.

In the next morning following the removal, open the top and see whether the frames and the dummy board are in their proper places, and adjust the spacing of frames, if necessary. Examine the hive after three days and see if the queen is laying. The pieces of wood at the entrance may be removed a week after. The hive may be brought back to the desired place in the apiary after a month.

Travelling Box for Bees :— If an established colony of bees on frames has got to be removed to a long distance either on the head of a bearer or by motor, rail or steamer, it is advisable to use a travelling box so that the risk of breaking the combs may be minimised and the displacement of frames may be avoided, and that the bees may not have any chance of escape through any aperture whatsoever, while on the way.

A travelling box (Fig. 71) is a specially constructed hive having top, bottom and entrance, and so made that the bees may be kept confined in it without the slightest chance of their escape, and that the frames may be kept rigidly in their respective places. It has proper arrangement for ventilation. Fresh air gets in from below and the used up air escapes through the top.

Such a box can be easily constructed with a fixed bottom-board having a ventilator 3″×3″. The box must have suitable ventilator on the top cover or at the sides. A piece of flat wood, of the size of the top

may serve as lid, and an arrangement for ventilation should be made in it by cutting out a hole 3″ × 3″ in the centre and covering it with a piece of wire-netting nailed on it and suitably protected. The box, if supplied with a flat roof, may also serve the purpose of a nucleus hive. The body box must have the usual arrangement for holding the frames.

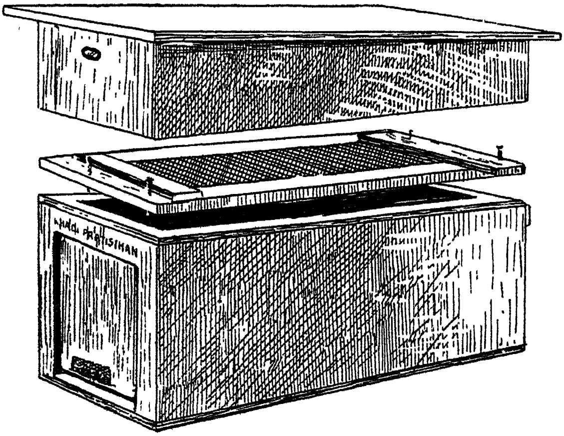


Fig. 71. Travelling Box for Bees.

Combs should be transferred to the travelling box during the early parts of the day, and two battens of proper size, padded with cotton and linen, should be placed over the shoulders of the frames at the two sides, and screwed down to the hive so that the frames may be held rigidly, being pressed by the battens; if necessary, small wedges may now be pushed in between each shoulder of the frame and the batten above. Close the top with the lid which must fall

flat evenly, without leaving any chink for the bees to escape. Screw down the lid.

The box should be kept on the hive-stand in its original position for the rest of the day, so that the bees may continue to work as usual. In the evening when the bees have stopped flying, close the entrance with a separate piece of wood and screw it down to the box. It is now ready for removal. It is better to feed the bees one day earlier before they are thus transferred to the travelling box.

While transporting, let the box be so placed that the frames lay in the same direction as the carrier is proceeding. This is to minimise the shock and any damage that may be caused to the combs by the jerking. Instruction should be given as to the proper way in which the box should be placed while travelling.

On reaching the destination, the box should be placed on the stand where the hive is intended to be kept, and the door unscrewed and opened. Bees will rush out, but there is nothing to be alarmed about. They will re-enter the travelling box after reconnaissance. Give the bees sufficient time to settle down, then unscrew and remove the lid and transfer the combs to a hive. The bees may be allowed to remain temporarily in the travelling box for a day or two if necessary, and they will work freely through the open door. In that case, the flat roof should be put on after the removal of the lid.

The door of the travelling box must not be opened if it be raining at the time when it arrives at the

destination, or if any high wind blows or there be any storm. For, the bees on rushing out after the confinement will either be drenched on account of the rain or blown away, and thus be lost. One should wait and avail oneself of the first opportunity in opening the door when it has stopped raining. In any case, the door should be opened in the evening when it is dark, even if it be raining; for, the bees will not be coming out then.

Bees must not be kept confined for a long time, because long confinement increases the heat inside the box; it is harmful to the grubs and exasperating to the bees. They make a sharp buzzing sound and press at the ventilators to come out. One can feel the excessive heat by touching the side-walls of the box. If the box arrives in such a condition it is advisable to place it, on arrival, in a cool dark room for some time, instead of opening the door, and spray water through the ventilators. The bees will calm down appreciably. After giving them time enough to soothe, cool down and recover from the shock of the journey to some extent, bring the box out, place it on the stand and open the door.

The author had occasions to open such boxes in which bees were confined for forty-eight hours and travelled a distance of about four hundred miles in the month of May, the bees numbering about 3,000. They arrived quite all right. Only a few bees died on the way.

CHAPTER XXI

UNITING STOCKS

The stocks should be kept strong from whatever stand-point it may be considered. Weak stocks cannot maintain heat properly and, therefore, the population cannot increase as quickly as the apiarist would wish. Weak stocks excite robbing, and robbers make a hell of it. Weak colonies are not economical. They neither can collect surplus honey when the flow begins nor can they pull through the rest of the year when the flow ceases. Dividing a colony at the end of the flow, after having reaped the harvest, has this drawback that with a new queen the nucleus, being weak at the close of the season, cannot build itself up or grow so strong as to pull satisfactorily through the rains and the winter. Scarcity of food will be the greatest hindrance. It is better, therefore, to check the temptation of increasing colonies out of season, either by dividing a colony or by capture. It is also desirable to unite the weak stocks. Queenless weak colonies should also be united instead of trying to re-queen them by rearing new queens. Colonies that do not satisfactorily cover at least three combs may be considered weak. (See 'Enlarging the Brood Nest', page 160 ; also the first para of Chapter - 14, page 187).

Uniting a Queenless Stock with a Queen-right one :—Move the hives to be united towards each other, two feet a day in the evening until they stand side by side by such gradual daily removal; or, move one of the hives in the evening directly beside the other just before uniting (see pages 242 - 243). In the latter case, place an obstruction-piece of wood at the hive-entrance in a slanting position (see page 242), soon after the colonies are united. Removal of hives for uniting should be effected only on bright days, so that the bees while going out next morning may note the change of the position of the hive.

The bees of different colonies have different odours, and, therefore, they behave themselves as strangers. They will resist each other and fight if one proceeds to unite them directly. Therefore, steps shall have to be taken to hide the individual odours of the colonies to be united, and give them one and the same odour so that they may accept each other and unite without the slightest resistance or suspicion. Having done this, the next step is to transfer the combs of one with the adhering bees, into the other. The hive from which the combs will be transferred, will have also some bees adhering to its side-wall, and it may be difficult to remove these bees after the combs are transferred. Precautions shall have to be taken against this also. The work of actualy uniting the the bees must begin in the evening when they have stopped flying. It has been already stated above that the colonies that are to be united should stand side by side. For the present, let us consider

that they stand so. As to the next step, proceed as under.

Open the hives in the afternoon and remove from both of them the combs that are not covered by the bees, also those that are partly covered but do not contain eggs or grubs. To avoid the adhering of bees to the side-wall, draw the combs of the queenless stock in the centre of the hive, keeping an open space uniformly on each side, and close them up with two dummy boards, on the two sides. The bees that were adhering to the side-wall will move on to the combs in a short time. Quilt the combs covering the dummy boards as well. Close the hive.

Quilt also the queen-right colony after the removal of the unwanted combs and arrange the rest that are left, from the side-wall of the brood chamber, as usual. The empty space that will be left in this brood chamber is to accommodate the combs of the queenless colony on uniting.

Now, in the evening when the bees have stopped flying, arrange a hiving board in front of the queen-right colony ; bring the smoker and make it ready for immediate use (see pages 91 - 93). When the fuel is burning in the smoker, add a pinch of gum-resin (*Dhuna*) so that the smoke may give a pleasant smell. (Cocoanut-husk, cut into small pieces, can satisfactorily be used as fuel). Contract the entrance of both the hives and make it about an inch. Now, smoke both the stocks a little ; apply three puffs of smoke at the entrace of each hive. On the application of the smoke, the bees will be thrown into commotion. A buzzing

sound will be heard from outside. Wait till the sound subsides. Apply two more puffs of smoke to each hive and wait till the sound subsides again.

Then open the hives, remove the quilts from both by rolling them out. Draw back the dummy board of the hive having the queen. Also draw back one of the dummy boards of the hive containing the queenless stock, and transfer the combs one by one into the other hive, keeeping proper space between the frames. When all the combs have thus been transferred, close them up with the dummy. Before the roof is next put on, feed the bees with sugar syrup by placing a bottle-feeder on the brood frames. Close the hive, and widen the entrance to its original size.

The bees that are adhering to the two dummy boards of the queenless stock should either be brushed into the hive before it is closed or on the alighting board after that; the bees on the bottom board should be brushed off on the hiving board. The work of uniting the colonies is thus completed. The empty hive should now be removed. Examine the hive on the third day to see what further attention is necessary.

The method, as described above, works most satisfactorily and without fail. The bees start work peacefully from the next morning as usual.

Another method of uniting is to place a sheet of ordinary newspaper over the frames of the colony having the queen, and then with a lead pencil prick a few holes along those portions of the newspaper that

lie between the top-bars of the frames. The next work is to raise the brood chamber of the queenless bees and place the same on the brood chamber of the queen-right colony, the perforated sheet of newspaper intervening between the two. The hive is then closed by putting on the top cover. In this method of uniting, there is no quilting and smoking. The bees above and below will cut out passages by enlarging the holes in the paper, acquire the same odour, and unite. Two days after, the empty combs should be removed from the upper chamber and the combs having bees and grubs, lowered down into the brood chamber below.

Uniting two Queen-right Colonies :—In uniting two stocks having laying queens in both, the question arises as to which of the queens is to be kept. Allow that queen to remain which is younger, bigger in size, looks healthy and a better layer, and whose worker progeny is known to be docile and a better forager. The apiarist must have his own choice in the selection, for, it may be guessed that all the desirable qualities are not present in either of the two. Therefore, keep that queen which is considered to be comparatively better and destroy the other by removing her from the hive. The removal of the queen is best done in the early hours of the day so that the work of uniting the colonies may be proceeded with in the evening, as has been detailed above.

Uniting a Swarm with a Queenless Stock :—Quilt the queenless stock in the manner described above; contract the hive-entrance, and for uniting apply smoke

as has already been detailed. (See pages 249-250). The swarm is supposed to be in the net; now apply a few puffs of smoke to the bees in the net; this can be done by holding the handle of the swarm-catcher in one hand and working the smoker with the other. Wait a minute so that the bees may calm down. If, in the meantime, the bees in the hive have become quiet, then remove the roof, roll the quilt off and draw back the dummy board to the end of the chamber. Now, shake the swarm of bees from the net into the hive. Cover the top with a piece of pasteboard and apply a few puffs of smoke through the entrance, for the second time. Wait for a minute, let the commotion subside, then remove the pasteboard; place a bottle-feeder on the top-bars of the frames filled with syrup and then close down the hive by putting on the roof. A few bees clinging to the net may be thrown on the hiving board arranged beforehand. The frames should be closed up with the dummy board next day; the queen may be examined then or three days after.

If a swarm captured in a swarm-catching basket or a box is to be united like the bees in the net in the above manner, then the swarm must not be smoked directly while in those receptacles. A cluster of bees without the queen, captured in the net or basket, can be similarly united with a queen-right colony.

Strengthening a Colony by adding Bees from another Hive:—This is possible only during the honey-flow season when the bees are mad after visiting

flowers and collecting nectar. The addition of bees can be effected simply by the exchange of position between a weak colony and a strong colony. It should be done in the afternoon, and as a result, a large number of foragers coming back from the field will enter the weak colony now on the stand of the stronger one and thus swell the population of the former without any fight or resistance. The few foragers of the weak colony will, in their turn, also enter the other hive.

The hives may thus be kept in their changed positions for the rest of the flow season if thought desirable. But if the stronger colony is to be brought back to its original stand, then it should be done in the evening when the bees have stopped flying ; the weaker colony now strengthened by the addition of bees must then be removed to a new quarter about 300 feet away from its original stand and all precautions taken as detailed in 'Moving Stocks' in Chapter - 20.

The thickly adhering bees of a comb taken out of a strong colony may be shaken off, in the flow season, directly into a weak colony on the top-bars of the brood frames, or on a hiving board so that the bees may get in through the entrance. They will unite without resistance, for, it is during this honey-flow season that the bees can afford to be generous to some extent.

CHAPTER XXII

BEHAVIOUR OF BEES

Modern bee-keeping is based on the scientific study of the behaviour of the bees from various aspects. It is, therefore, that to learn the art of keeping bees successfully, one should have a thorough knowledge of bee-behaviour and study it intelligently. Some of the peculiar habits, manners and activities of the bees will now be described.

Play-flight of Bees :— The young bees learn to fly and they take their flights in front of the hive when the atmosphere is appreciably warm and the sun shines brightly. They thus seem to play. During these flights they discharge their excrement while on the wings ; they also carefully note the landmarks and other bearings, so that on undertaking field work they may find their way back without difficulty. They also come out during the rainy days when there is a cessation for a couple of hours between the showers. They come out in sultry cloudy days also. These flights take place generally once a day after about 10 A. M. But they are also seen to come out once, earlier in the day, and again in the afternoon. In summer, it has been observed that the young bees of some of the colonies take such flights even thrice a day.

A few bees begin to fly at first. They come out of the hive-entrance and on taking wing, turn round and keeping their look towards the hive, fly timidly two or three feet away from the entrance ; they come back, alight on the board and enter the hive. The flight distance extends as more bees rush out, but they keep themselves within about twenty feet of the hive. One may mistake it for the issuing out of a swarm. In play flights, the bees calm down in about five minutes, but in swarming out they gradually extend the area of flight and slowly move away from the front of the hive and are cut off finally. But the madness and frenzy in rushing out of the hive are of equal intensity in both the cases. (See 'The Issuing Out of Swarm' in Chapter - 25). One must not mistake the play flight with the activities of robbers. For, the robbers at the start, fly at the entrance in such a way that they might not be seized by the defending bees. (For the signs of robbing, see pages 232 - 234).

Artificial Feeding and Rushing Out of Bees :— It has been found that when a bottle of syrup is given to a starving colony in the evening, it is followed by an excitement among the bees. Some of them rush out being very much agitated ; they fly near the entrance and in front of the hive. From the very nature of their movement it may be guessed that they are trying to find out the source of supply and to understand how it could be possible to get food when there was nothing. The bees rush out even if it be dark at the time. They hurriedly walk about the alighting board as if they are in search of something ;

they take wing, reconnoitre and being unable to find out anything, come back and enter the hive.

Scout Bees :—During the swarming time when the issuing out of a swarm becomes imminent, the scout bees go out to find a suitable place where the swarm, after coming out, may conveniently take shelter and build a home. The swarm on being cut off from the hive, settles close by, forming a cluster. The bees wait for the return of the scout-bees for the desired information. If the place had been selected before swarming out, they will stay only for a short time after forming the cluster, so that the scouts may return and lead them to the new abode. The cluster may break within a few minutes after the bees have settled or may stay on for some hours, before they move away to an unknown destination. Generally they stay for about an hour. The maximum period of stay observed by the author was five hours. Sometimes they do not form any cluster but fly straight away very fast.

Scout bees fly about the dwelling houses and other possible places in search of a shelter *with a peculiar hum* ; this particular sound or the note which they give out during their flight is quite different from that which is heard when the robbers suspiciously fly round a hive or near a hive-entrance. In the forenoon they go out and search every nook and corner, far and near. If during the swarming period, scout-bees are seen flying near about the apiary, and if the apiarist had not taken proper steps in controlling swarm, he must be sure of a swarm issuing out soon ; it may issue even on the day, from one of his hives.

The author once had an opportunity of hiving a wild swarm by decoying the scout bees in the following way : On the 17th February, 1937, a single worker was seen flying in a bed room at noon. Bees were also seen on the same day humming under the eaves and near the ceiling of another building. The next day a few bees were again seen at noon, humming round an adjoining building. In the same afternoon, about 25 bees were seen in the above-mentioned bed room, circling round an almirah the doors of which were ajar at the time. They also moved about here and there and cleared away by 5 P. M.

On the day after next, the scout bees appeared again at 12 noon and approached the almirah ; some of them went inside through the partly-opened doors. Just to entice the scouts, 2 frames were immediately placed in the almirah fitted with comb-guides smeared with honey. A feeding bottle filled with a small quantity of syrup was also kept suspended near the frames in an inverted position. Attracted by the smell, some of the bees sat on the comb-guides and some on the feeding bottle. An empty hive was then brought in and placed on a stand in front of the almirah. The frames with the bees on were then carefully transferred from the almirah into the brood chamber. A third frame having a fully-built comb was also placed in the brood chamber. The feeding bottle was then placed on the frames. The roof was next put on, and the entrance kept open. Some of the bees flying in the room also entered into the hive. After about five minutes, the bees came out

of the hive one by one and left the room, and in a few minutes all of them cleared out. The hive was kept on the stand undisturbed. The scouts were not seen during the rest of the day.

Attention was drawn on the fourth day at about 1.30 P. M. by a tremendous humming, and it was found that a swarm was entering into the bed room through the windows and rushing into the hive ; very soon the room became full of bees. They heaped themselves at the entrance, and thickly covered the alighting board. After the first rush was over, they were seen walking in a stream into the hive with raised abdomen.

The swarm came from an adjoining garden. Within fifteen minutes, the bees found their way inside the hive, and by 2 P. M. the room became so quiet that it was difficult to make one believe that only a quarter of an hour ago the atmosphere was resounding with the hum of a swarm, and that the hive in the bed room contained live bees. They started the normal work from the next morning. The hive was removed to the bee-yard after a week.

Queenlessness :—Queenlessness is not uncommon in an apiary. The queen may die accidentally in handling a swarm or capturing a wild colony. Sometimes the queen may be lost on account of the bad manipulation of frames. Virgin queens are sometimes devoured by birds when they come out on mating flights. They sometimes fail to return on account of high winds. Sometimes they alight on the wrong hives after the nuptial flights with the result that while

on the alighting board or on entering the hive they are either balled and killed, or in turn kill the reigning queen of the colony. Queens also die their natural deaths.

A queen that fails to lay egg in the right place of the cell, whose ovipositor has become bifurcated or somehow become defective, or who cannot lay eggs due to some other cause, has got to be removed. Unimpregnated queens, queens that are injured and, therefore, have lost fertility, old queens that have lost the power of laying sufficiently or become drone mothers, and queens that have become useless due to any other defect, must be removed and replaced by better queens.

Supersession of Queen :—Bees seem to understand that the welfare of the colony depends on a good fertile queen. So, in order to save a colony from ruin, they sometimes replace the old and worn-out reigning queen when she shows signs of failing. In order to supersede such queens, bees prepare supersedure queen-cells which number only a few. One may find two to six of such cells ; occasionlly they may prepare a few more if they find it convenient. Cells may be found as are just started or are in different stages of formation having eggs in some and grubs in others; one or two sealed cells may sometimes be seen. This peculiarity in the formation of queen cells is helpful to the bee-keeper in distinguishing the supersedure cells from the swarming cells. (See 'Preparation for Swarming' and 'Signs of Swarming' in Chapter-25). At the approach of and during the

swarming season, the supersedure cells often excite swarming impulses.

Supersedure cells will generally be found on the edge of the comb, at the bottom and at the sides. They are sometimes found on the face of the comb; this happens when the bees do not get eggs or suitable grubs on the edge of the comb. (See 'Queen Cell', pages 45-46). Supersedure cells may be started at any time of the year according to the need of the colony. But, as we find here, they are more in evidence from the middle of June to the middle of August, i. e. sometime after the close of the honey-flow season if the colony had not been re-queened by that time and the population is on the decline. This is about the Plains-type of bees. And yet, it has been observed that some of the queens would go strong even in the second season, serve fully, and then show signs of failing.

How the workers persistently try to supersede a queen may be understood from the following instance. On the 19th of March, during the height of flow, it was found by the author that a Hill-type queen had stopped laying for some time. There were no eggs or grubs. Two queen cells were found, one on the edge of a comb at the bottom, and the other on the face. It seemd, therefore, that the queen was failing. She was 17 months old then.

The colony was divided; the queen was allowed to remain in her own hive in the old place; the nucleus, containing the queen cells, was removed to another position. On the 27th March, the queen was found laying; grubs were also found.

On the 18th May, grubs and eggs were found but the queen was observed to have been reduced in size and looked very sickly; her appearance roused suspicion. On a careful search a virgin queen was found. The colony was again divided. The virgin queen was hived separately, and a few more combs were taken out from the stock along with the adhering bees.

On the 10th July, a virgin queen was again found. The old queen was, of course there, but her colour was much faded; it changed from black to ash. Evidently she was nearing her journey's end. There were grubs and eggs. The virgin queen was again hived separately, and the old queen was kept in her hive on the old stand.

On the 12th August the hive was next examined. This time, at last, the queen was missing. Three queen cells were found having grubs in different stages. So, five months after the first formation of the two supersedure cells, the queen disappeared. It may be that she died a natural death, or that the workers, baffled so long, got rid of her on the fourth time after providing themselves with those cells for raising a new queen.

Signs of Queenlessness :—Every queen has her own peculiar odour. She is continuously on the move, over the combs, in search of cells for egg laying. Her perambulations from comb to comb and the particular 'queen-odour' make the bees feel her presence in the hive. The absence of the queen by removal or otherwise is, therefore, immediately detected by the absence of the queen-odour.

Signs of queenlessness are very marked. A general excitement, hurry and bustle prevail in the hive. Sometimes the whole colony is affected, and sometimes only a part. Bees come out in search of the lost mother and with great hurry move about the alighting board, the side-walls of the hive, the roof and the ventilators.

They take wing, fly in front of the hive, circle round it, and make a peculiar hum in search of the queen. It is a cry of distress. If the bee-keeper happens to be present at the time beside the hive, the bees will hover round his head in search of her, approach his forehead, eyes, ears and chin, as if asking whether he can give any information of their lost mother, and will fly round his body and approach his hands and legs trying to find her out. The bees coming from the field are anxiously approached by the searching workers on the alighting board, and they try to know if any information can be got from them.

A peep inside the hive will show the same anxious move of the bees over the top-bars, combs, side-walls and the bottom board with a peculiar buzz. This rough buzzing sound can be heard even if one stands beside the hive. Unmistakably these are signs of their mental agony and expression of the great misfortune that has overtaken the colony.

In the first impulse a few bees scatter over the alighting board and rush out in the air. They are followed by some more bees. They fly hither and thither, search the ground in front of the hive.

Wearily they come back and settle on the front wall of the hive beginning from the entrance, but most of them enter the hive. This clustering at the door is a peculiar sign of queenlessness. The cluster may break soon after or may remain till evening when the bees will slowly enter the hive. The same process may be repeated next day but with less intensity. It may continue for three or four days.

Bees loiter near the entrance and begin work half-heartedly. Those coming from the field are not in a hurry to enter the hive, and go in wearily. An atmosphere of despair and inaction, sorrow and inattention prevails. The behaviour of the queenless bees is so peculiar, the signs of despair and sorrow are so clear and striking, that one cannot fail to detect these expressions of the loss of the queen mother.

The signs of queenlessness are more marked and expressive in the Hill-type of bees. It has already been stated that these bees are shy. They become more so when brought down to the Plains. Virgin queens of this type are more apt to take wing when combs are taken out for examination, specially those queens who have become unsuccessful in mating within a week after the first flight.

Laying queens rarely leave the combs while under examination. The author once lost a reigning queen of the Hill-type while the combs were being transferred to a brood chamber in changing the hive. The queen took wing out of fright. We moved away and the hive was kept open for the queen

to return. Close watch was kept, but the queen did not come back. She was searched for but could not be found ; she was lost. She did not alight on any wrong hive. She took wing 15 months after her last flight. She could not be expected to have remembered the bearings of her hive, but she could have easily returned following the workers that were returning to the hive from the field. This she did not. There were brown ants on the shed overhead. It may be that the queen on alighting on the shed for rest was seized by the ants and devoured.

Within five minutes of the loss, a slight excitement was first noticed which increased in volume, ultimately resulting in a vigorous commotion, and within another three minutes bees rushed out. It seemed that the whole hive had been emptied. They began to whirl round in front of the hive. It seemed that they were absconding. This continued for a few minutes. Slowly they began to come back and settle on the front ventilator and clustered. Only a few entered the hive. Some began to walk on the alighting board aimlessly. They looked very nervous, once entering the hive and coming out at the next moment. The colony was strong and the combs were full of eggs as also grubs in all stages.

In the afternoon they began to enter the hive very reluctantly. By the evening almost all the bees entered the hive leaving only a small cluster. The same excitement was noticed on the next day but it was less intense, and normal condition was practically restored on the third day. The hive was examined on

the fourth day and a single queen cell was found having a grub just hatched.

Two Queens in a Hive :—Only one queen is tolerated in a hive under normal conditions. But there are exceptions. Sometimes two queens, mother and daughter, are seen laying eggs on the same side of a comb, or on the two sides of the same comb, or in different combs of the same colony. In these cases, if left to themselves, the old queen will be found missing within a short time. Either she dies a natural death or is killed by the rival daughter or by the workers themselves. Such queens, if found, may be hived separately by dividing the colony, but it is better to remove the old queen and allow the young one to reign.

Two queens, mother and daughter, were seen by the author in a hive on the 25th of August, laying eggs in one and the same comb. Prior to this, the hive had been examined last on the 17th May when there was only one queen. She was fairly prolific, good looking, healthy, robust, $\frac{7}{8}$ inch in length, and aged 18 months. Up to the time she did not show any signs of failing. No queen cells were found on the 17th May. Examination of the hive on the 25th August revealed the presence of the two queens laying. The young queen was first noticed on a comb, and being suspicious, the combs were carefully searched and the mother also was found. Both were allowed to remain. Two weeks after, the hive was examined on the 7th September and it was found that both mother and daughter were laying eggs. Their movements were

quite normal and the workers were found to be unconcerned. But after another fortnight when the colony was next examined, the old queen was missing.

The presence of two queens in a hive is not so rare as one would think, for, several such cases have come into our notice from time to time; and this must be the experience of other bee-keepers too. As has been said above, it is better to remove the old queen at the first opportunity, and keep the new one to head the colony.

Caressing the Queen :—The workers fondle and caress the mother when she gets tired and wants to take rest. It will sometimes be found, while examining the combs, that a queen is sitting quietly, her abdomen touching the cells, and some workers are sitting round her in a circle with their heads facing the queen. Some of the bees may be found even sitting on the back of the queen cleaning and combing her with the aid of their mandibles and tongues.

Dance of the Bee :—While examining the bees and the combs during the honey flow season, the keen eyes of the bee-keeper will notice the dance of the individual bee on the combs at different places. These dances are of two kinds,—(1) the *nectar dance*, and (2) the *pollen dance*.

(1) Nectar Dance :—The nectar dance is also called the 'round dance'. By this the dancing bees communicate to others in the hive the discovery of nectar at a certain place. As usual with the other bee-keepers the author also had occasions to observe closely the nectar dance of the bees on the combs.

Standing on a cell, surrounded and closely observed by other workers just beside, the dancing bee after quickly carving a circle with nimble and measured steps once to the left, would move round to the right, back again to the original position with the same quickness and rhythm. She would sometimes cover more than a circle, and sometimes would reverse the direction after covering only a portion of it. She would be dancing thus for about a minute, sometimes a little more and sometimes a little less. It has been noticed that the dancing bee instead of restricting her stand on a single cell, would slowly extend her pace to about six cells in a circle, while dancing round and round to the right and to the left.

The workers by the side, in their wonder, closely mark the movement of the dancing bee, try to understand it, and as if to know more, would touch her with their feelers while the dance is on. Dances of several bees go on at the same time on a comb at different places on one side or on both the sides. Simultaneous dances of several bees on different combs in a hive have also been noticed. This pleasurable excitement of merry dance by particular bees here and there on the comb seemed, on observation, to be very nearly contagious, as if the dance of one bee induced, within a very short time, a similar dance in another bee close by or just a little off. Then again, while some dancers stopped their performance, others began exhibiting the art at their own convenient places.

The very gait of the dancing bee is attractive, and the display of the art is elegantly harmonious and admirable. She seems to exclaim—'Look, how I dance'! But for what ? Is it merely the fancy of certain funny bees that they begin the dance on arriving home, on account of the good feed and enjoyment that they had at a certain source of plentiful supply, and to humour the other workers in the hive, to make life easy for the day's hard toil—the flow season being on ? Surely it excites one's imagination to find out the reason.

It is most interesting to learn how with the dance of the bee as the index, Dr. K. von Frisch, of the University of Munich, conducted a series of experiments and deciphered the signs and made out the secret language of the honey-bees. He delivered a lecture on "The Language of the Bees", at the University College, London, in March, 1937. It was published in the Annual Report (1938) of the Smithsonian Institution, Washington. We shall now pass on to that lecture.

The Language of the Bees :—To understand the language of the bees, Prof. K. von Frisch first referred to the colour sense of the bees and then to the scent, as flowers have their colour and scent to make themselves more striking for the visitors. Thus the insects easily find them, get their food and guarantee the pollination of the flowers.

He then described in detail his experiments to find out whether bees can distinguish colours. For this, the bees were trained to blue colour and

experiments showed that they could distinguish it without any hesitation. Training to orange, yellow, green, violet or purple gave him the same good results. The conclusion, therefore, was that the bees have colour sense. But bees trained to scarlet red showed that they were red-blind. As to bees visiting the red flowers of poppy, he said that these flowers reflect many ultra-violet rays which they are able to perceive. Further experiments showed that the bees confused blue with violet and purple.

Now, about the sense of smell. His experiments showed that bees can distinguish the smell of different scents, and that the scent guides the bees to the food. The scent of most flowers cannot attract bees from a great distance. But then the scent has the advantage of being perfectly distinct for each species of flower. Thus the scent permits the definite recognition of flowers from close quarters.

As to the function of the scent he said that it was to attract the scout bees to visit the flowers as they fly out in all directions in order to find out a new feeding place. But the scent also served as a guide to the foragers to recognise a certain class of flowers from which they were already collecting nectar and to distinguish them from other kinds of flowers.

Then he referred to one more function of the scent which he considered to be the most important and that was in connection with the language of the bees. He noticed that as soon as one bee had found honey on his experiment table, others appeared within a short time, and they all came from the same hive

as that of the first discoverer. So the conclusion was that the first bee must have communicated the discovery to others in the hive, and the question was how could she communicate.

To clear up this matter by experiment, Professor von Frisch used an observation hive specially constructed, in which the combs were so arranged that they all formed a large comb which could be seen through the glass windows. He marked the bees under experiment with spots of different colours on the fore part and hind part of the thorax, as also on the abdomen to indicate their number so that every bee may be recognised individually at sight from amongst a lot of others at the experiment table and on the comb.

Professor von Frisch, then traced the marked bees from the feeding place to the hive and noted their dance on the comb. But whether it is the Indian Bee whose dance we have already seen, or whether it is the European Bee that danced under the eyes of Dr. von Frisch, their style is the same.

As to the dance he said that a bee which had discovered the feeding place was marked with colour and observed in the observation hive on her return. She started dancing, finished it just as suddenly as she began, hurried to the hive-entrance and returned to the feeding place. He gave a full description of the dance and the interest taken by the bees round her and their movements. He found that soon afterwards, new bees came to the feeding place and after returning to the hive they also danced; and as

more bees danced in the hive the more appeared at the feeding place. It was clear, therefore, that the existence of food was communicated to the bees in the hive by the dance.

He gave full details of his experiments and investigations. And in summing up he said that when the scout bees discovered in a region a new kind of flower full of nectar, they reported it by dancing on coming back to the hive. The scent adhering to their bodies indicated the kind of flowers that were blooming and to be searched out. The bees so communicated with, fly out in all directions, and they seek something definite by the scent and find it out.

He found a correct proportion between the collecting bees and the quantity of food offered by a certain class of flowers. The bees did not dance any more when a sufficient number of them had been drawn for collection, when the flowers no longer yielded enough nectar and when nectar had been scarce.

Bee-keepers all over the world are indebted to Dr. von Frisch for his experiments and researches in finding out the language of the bees. This language of the bees and the method of communication are wonderful. It brings to mind, at the same time, the amazing ways and methods of the Creator who taught them this dance—the only means of communicating the message of the discovery of a good feed so that all other workers of the colony may have their share. And in tune with the 'dance', they must be singing His glory.

(2) **Pollen Dance** :—The pollen dance is also called the 'wag-tail dance'. A certain bee with pollen on the hind legs will be seen swiftly wagging her tail right and left, standing somewhere on the comb. Sometimes she will turn round to the left or to the right and start wagging the tail again for a few seconds. Then she will move forward in a great hurry, and then halt, and again start wagging the tail. This she will do for sometime. On carefully looking round the comb, one will notice the same wag-tail dance going on here and there, taken up by a few more bees also. Thus they draw the attention of other bees in order to communicate the abundant supply of pollen discovered in a certain pasture. And this is to induce the other foragers to avail themselves of the opportunity in collecting it for the colony.

Balling the Queen :—This is clinging and clustering of a number of bees round the queen, and pressing her hard from all sides. A round mass like a ball is thus formed. It results in the death of the queen so 'balled'. (See 'Balling of Queen', page 238).

Queen's Piping :— During the swarming time a sharp, shrill, long-continuous note may sometimes be heard from a hive at an interval of a few seconds. This is the queen's 'piping'. It sounds like 'p-e-e-p', 'p-e-e-p'. It is a note of challenge by a virgin queen to her rivals in the queen cells, or to another virgin or to the reigning mother. It is, in one way, a note of danger to the bee-keeper. It indicates that a virgin queen is walking on the combs to fight out her rival.

If there happens to be a young queen in the cell which is about to emerge, a dull suppressed note may also be heard from her as a reply to the challenge that she too is coming out to fight. It is advisable to open the hive when the 'piping' is heard and find out such queen or queens and set the matter right.

On opening a hive after having heard two separate piping sounds, the author found on one occasion that a virgin black-queen had been 'balled' on a comb and that she was piping at intervals. A separate low 'p-e-e-p' was also heard from another part of the hive, when on examination the reigning queen (Plains-type) was found encircled, being protected and caressed by about a dozen workers. But their protection was of no avail, for, she died in less than fifteen minutes. It seemed that she died out of fright. The black-queen was also rescued, but she too could not be saved, for, by that time she was terribly injured on account of balling. The thing was that the virgin queen went out on a nuptial flight and on alighting on a wrong hive brought her own death and caused the death of the other queen.

From time to time the author had occasions to observe the movements and dispositions of the 'piping' queens. On another occasion, a virgin queen was seen piping and hurriedly walking over a comb, chased by some workers. The comb which had the queen on, was found on examination to have two ripe queen cells protected by workers. There was some amount of commotion and the bees were found to be very agitated. It seemed that they were in a

mood to swarm out, and this was after the prime swarm had been thrown off two days before. The queen was then hived separately and soon the excitement of the bees calmed down. The virgin queen also stopped piping.

The movement of the queen was carefully observed while she was piping. It was noticed that the queen while walking hurriedly over the comb, stopped suddenly, crouched on the comb, bent down her head, pressed hard the mandibles against a cell, began to vibrate her wings very rapidly and issued forth a long-continued shrill—'p-e-e-p'. Next, she stood on her legs, again walked in a hurry to some distance as if something had happened and she must attend to it, suddenly stopped, repeated all the movements of the body as before and issued forth another 'p-e-e-p', and this continued till she was removed and hived separately.

Scrubbing Movement of Bees:— It has been observed that the bees while adhering to the inside walls of the hive, sometimes move to and fro, keeping themselves within their own places. A bee with the mandibles touching the plank of the hive will go forward a step or two and quickly retrace her steps again back to the original position. She will be continually repeating this movement as if scrubbing the wood with the mandibles. The whole lot of bees that crowd the hive walls, the top bars, the bottom board, the entrance and the alighting board will be found to be behaving like that. A few bees may also be noticed to do the same thing even on the combs.

A peculiar sound is raised by such movement of thousands of bees and it resembles the rumbling sound of a distant railway train running at a speed over a bridge. At times the sound can be heard even on standing beside the hive. By this peculiar movement of their body the temperature of the hive is raised as could be felt by touching the walls of the hive.

This strange behaviour of the bees has been noticed by the author in several hives, particularly in the rainy season, sometimes also in December, and sometimes in February on the approach of the flow season. It has been further observed that while some of the bees indulge themselves in that scrubbing movement, others of those hives attempt to build combs and respond fully if fed artificially.

Removal of Eggs by Workers :— It is found sometimes that a queen just after impregnation, being a novice and not accustomed to egg-laying, would lay at the start more than one egg (two or three eggs) in a cell. In such cases the workers remove the extra eggs from those cells, keeping only one in each. The queen, of course, corrects herself within a short time.

Another rare vagary of the newly-mated queen, as observed by the author, is to lay egg high up on the cell-wall. The workers remove such eggs, and drop them down on the bottom board. The queen also corrects herself soon, but she cannot do that when there is any organic defect in her. In such a case the defective queen must be removed to make room for another.

Then again, when there is scarcity of food in a colony, and the queen instead of restricting her egg-laying goes on laying without restraint, the workers keep only as many eggs as could be reared up and throw away the rest. When the population of a colony decreases due to some reason and the queen lays so many eggs as could not be covered by the bees, the workers in such cases too, remove and throw out those eggs that remain uncovered. (See 'Feeding : A Stimulus to the Queen', page 166).

When in queenless colonies, laying workers begin to deposit a lot of eggs in a cell, the bees remove all the extra eggs, keeping only one in each and from such eggs only are drones born.

Control Bees :—Some of the adult bees keep guard near the entrance. They sometimes walk up and down the alighting board. They are always alert and ever suspicious. When any danger is apprehended, or when the guards get frightened somehow, one or more of them will dart at the intruder. When there is any cause of annoyance and when they fancy that the enemy is close by, one or more of these guards will take wing and make a peculiar 'boo' and circle round the hive and near the entrance as a warning to the colony that danger has been scented. Beginners often get stings from these bees while cleaning the alighting board or moving the hand near it carelessly.

It has been observed that when a bee comes out of the hive-entrance in quick steps, obviously with the object of going out for foraging, but stops suddenly and begins to scratch her head as if thinking whether

she will stay at home or take the trip, one of the guards would come at once and simply push the hesitant out into the air. No amount of dodging can help such laggers to evade the control of these bees.

Light : Its effect on Bees :—Bees prefer a dark corner to build their home, and the artificial hive is made to fit in with their natural inclination. When in the morning the first glimpse of light plays on the hive-door, bees come out and start work. It continues till the evening. A bright sunny day is ideal for foraging, and they do not mind either the glare or the direct rays of the sun when visiting flowers in the open field. But at home, inside the hive, they appreciate and enjoy the dark, cool corner. A sudden flash of light and glare inside the hive startles them. If the reader happens to know something of photography and the dark-room work, then he must be aware how light affects the eyes on coming out of the dark-room. He will now understand how irritating it would be to the bees if a hive top be opened all on a sudden exposing the stock, without giving the bees time enough to accommodate their eyes to the glare. Therefore, whenever a hive is to be opened during the day for examination, raise the top slowly so that the bees may adapt themselves to the light and behave properly, otherwise they are sure to be cross.

Then again, bees remain indoors at night. A bright artificial light near about the hive or a ray of bright light coming out of a room through any opening, will induce them to come out. And whenever a bee gets inside a room following the rays of light,

it is sure to be troublesome and annoying to the inmates. Therefore, always avoid an artificial light near the hive at night.

Rest and Sleep of Bees :—Bees also have their periods of rest, though it may be for a short while. A few bees may be seen sitting still on a comb for sometime without attending to any duty or walking very slowly without any aim. That is the period of rest. Sometimes a few bees may be seen to have entered deep into the cells, with only the tip of the abdomen protruding out. Thus they lay motionless. Rarely will they respond if pricked gently with the knife-blade or when air is blown. If pricked hard or blown vigorously, unwillingly and with some effort will they manage to come out, with the abdomen foremost, and look round wearily. Thus taking rest inside a cell, should be taken as the bee's sleep.

Once the author noticed a bee taking rest in a peculiar manner in the hive-entrance. With the hind legs up and touching the upper side of the door-slot, and the head down, getting hold of the bottom board with the front legs, she stood motionless. It was afternoon then. The foragers were busy going in and coming out, but the sleepy bee took no notice. Some of the foragers brushed past her, but she stood in the same posture quite unmindful. Air was blown on her vigorously, yet she did not respond. Ultimately she was dislodged by pushing with a knife-blade. She then seemed to be annoyed, walked a few steps on the alighting board, and then slowly went inside the hive.

Bee Sanitation :—It seems that the bees know a great deal about sanitation. They never soil the comb or the hive. They discharge their semi-liquid excrement while on the wings, on their way to the fields for foraging and back. They also come out for cleansing flights (see 'Play-flight of Bees', page 254) and thus rid themselves of the fæces. The queen is an exception to this ; once mated she does not generally go out. And it has not been the lot of many experienced bee-keepers to see a queen pass any excreta. However, it has been pointed out that a queen does evacuate and rid herself of a highly watery fluid outside the comb, with great force. It has been further suggested that the formation of this watery fluid, in the case of the queen, is due to her feeding on royal jelly.

Bees die outside the hive. Sometimes they are seen apparently drinking nectar from the flowers with their heads pushed in and the abdomen raised up. But in fact they may have breathed their last in that position, and remained in that life-like posture on the flowers even after death. Life being extinct, just a little blow of air will make them fall to the ground. During their trips in visiting the flowers and coming back to the hive, they drop down and die. It may be truly said of the bees that they die in harness.

If a bee happens to die in the hive at night, next morning a scavenger-bee will be noticed bringing out the carcass. Firmly holding the body she will fly far away, rise high up in the air and drop it there. Dead bees are seldom found on the bottom board.

When due to old age, continuous toil and overwork, a bee finds herself incapacitated and worn out, unable to be of any service to the colony, when she understands that her end is coming near, she will deliberately come out of the hive, walk straight over the alighting board, fall to the ground and will still walk on in great hurry to the region unknown. Out of pity the author tried repeatedly, on many occasions, to keep such bees comfortably inside the hive, raised them to the alighting board, and pushed them in. But no. They came out to meet the inevitable. Nothing could make them stay in.

Weak and defective young bees are sometimes found to be pushed and driven out of the hive by the adult workers ; and once driven out of the hive, no effort of the bee-keeper can make them stay. It seems they realise that they are not wanted and, therefore, face death outside the hive.

CHAPTER XXIII

INCREASING BEE COLONIES

In the Plains, the main honey flow occurs in the spring. The honey season is also the swarming season. During this swarming period strong colonies can be divided at a suitable time in order to increase their number. The natural swarming should have to be prevented, for, it not only weakens the parent colony and retards the production of surplus honey, but it disturbs the orderly progress of work, and distracts the bees. It breaks the quiet atmosphere of the apiary and excites the swarming fever in other colonies.

Colonies nursed carefully and raised to overflowing strength early in the season can profitably be divided artificially. The artificial division reduces the swarming propensity, and the nuclei thus formed early in the season will, in all probability, attain full strength to yield surplus honey. Divisions may be effected in the following ways :

(1) **Forming a Nucleus from a Colony** :— On a bright day when the bees are flying freely, open in the afternoon the hive that has been selected for division. Remove two brood combs containing grubs in all stages as also eggs along with the adhering bees, and place them in a separate hive. Also remove one of the side combs containing honey and pollen and place it also in the new hive and close up the three combs

with a dummy board. See that the reigning queen has not been removed from the stock. And, if by chance any of the selected brood combs happens to contain the queen, then she should be removed from it. This can be done by returning the comb in question to the stock and placing it in such a way that the queen touches another grub comb in the brood nest. Wait for a minute or two and then examine if she has left. She may be removed to the stock with the aid of a feather. (See 'Removing the Queen', in Chapter - 24).

Allow the nucleus to remain on a stand just beside the stock for the rest of the day and remove it in the evening to a suitable new site when the bees are not flying. Put obstacles at the entrance and also take other necessary precautions so that the bees on coming out next morning may understand the change of place and note the new bearings. If on account of the return of some of the bees to the stock the population of the nucleus reduces to a great extent, then take out a comb from the stock and shake off the adhering bees into the nucleus, returning the empty comb back to the stock.

Bees in the nucleus being queenless will build queen cells and rear a queen. It is advisable to keep only one or two ripe, well-developed and healthy queen cells and destroy the others. (See pages 161-163). The virgin queen in due course will mate and begin to lay. It is a good practice to give a grub comb to the nucleus as soon as the queen emerges from the cell, for, it not only helps the bees to apply themselves

to their work with greater attention and vigour but it also helps the queen in several ways.

Instead of losing time in raising queen cells for rearing a queen, a ripe queen cell, if available from any other colony, may be grafted. (See 'Grafting Queen Cells', page 163). A good, fertile queen, if available, may also be introduced. (See 'Introducing the Queen', in Chapter-24). It is better not to introduce a virgin queen, for it has been found that the bees are very reluctant to accept a virgin, and then again, after mating, such queens do not, in most cases, prove to be very satisfactory. To enable a nucleus to build up quickly, grub combs taken out of other colonies should be added after shaking off the adhering bees.

The nucleus should be fed if required. Fresh frames with comb-guides or foundation should be added to it from time to time as the population increases till the hive is filled with the full number of frames. (See page 160). The empty space in the parent hive should also be filled up with fresh frames from time to time till the colony is raised to its full strength again.

(2) **Artificial Swarming** :—Select a strong colony and open it in the afternoon when the bees are briskly working. Take out the brood comb containing the queen. Examine the comb and remove the queen cells, if any. Place the comb in an empty hive ; also place in it two more empty combs if available, or two wired-frames fitted with foundation or comb-guides. Close up the three combs with a dummy. See that the brood comb containing the queen lies between the

two empty combs. Remove the parent stock (now without its queen) to another site, and place the new hive (with the queen) in the old position. The bees that were in the field, collecting nectar and pollen, will return to this new hive in the old place and swell its population.

If the stock, now made queenless, happens to contain queen cells, then only two should be kept and others broken down and destroyed. In the absence of queen cells, bees being queenless, will build queen cells and rear a queen. In spite of the precautions taken to make the bees of the stock understand the change of place, some of them will return to the old place and join the queen, and if on account of this, some of the combs of the stock happen to be without sufficient bees, then those combs that are not fully covered should be returned to the new colony in the old position.

(3) **Forming a nucleus by taking combs from a number of colonies** :—Without unnecessarily weakening a single stock in forming a nucleus, it can be done with the help of a number of colonies. Take out two brood combs from two different colonies, shake off the bees from both the combs and put them in an empty hive. From a third colony remove a grub comb having eggs in its lower part and place it, with all the adhering bees, in the new hive between the two combs that are already there. See that the queen has not been removed from the third colony while removing the comb with the bees on. Close up the combs of the new hive with a dummy board, and close

the top. Place the third colony on a separate stand just beside and put the nucleus on the old stand thus vacated. The flying bees of the third colony will now occupy the new hive and increase its population. In the evening remove the nucleus to a new site for queen-rearing and place the third colony on its original stand. The nucleus should be fed for a few days. The production of surplus honey in the colonies will not be affected much if the combs are removed in this way in forming a nucleus.

(4) **Utilising a natural swarm** :—If in spite of all the precautions taken in controlling swarm, a natural swarm issues out of a colony then it should be captured and hived. The following procedure may be adopted : Take out a grub comb from a colony, shake off the adhering bees, remove all the queen cells that may be found in it and place the comb in an empty hive; also place in the new hive three empty combs or wired frames with foundation. Find out the colony which has thrown out the swarm, remove it to a new site, and place the new hive on that stand. Now shake off the captured swarm of bees into the new hive directly over the frames, or run the bees into the hive with the help of a hiving board. (See pages 133-'38). Feed the bees for a few days. Hiving is best done in the evening. If for any reason it becomes impossible to ascertain the colony from which the swarm came out, then the bees can be hived at any desirable site.

(5) **Making use of a swarmed stock** :—If the colony that has thrown out the swarm, as referred

to in No. 4 above, could be found out, then it should be removed to a new site. A lot of queen cells will be found in it. This stock, keeping its population in view, can now be divided into two or more nuclei according to the number of combs that it has got. Only two well-formed cells should be kept in each nucleus for rearing a queen; two queen cells, because the first queen on emerging will kill the other prospective queen in the cell; and in the event of the failure of one cell the other will serve the purpose. (See page 162).

The swarmed-stock must not be divided if the bee-keeper intends to get honey from it, but destroy all the queen cells excepting two for queen-rearing. And if, perchance, after issuing out of the prime swarm a cast comes out on any subsequent day, then it should be captured and returnéd to the stock, and in that case any virgin queen or queen cell found in the stock should be destroyed. The cast may also be hived separately if so desired, but it would be better to return it to the stock, as otherwise the stock will become so weak as not to be of any appreciable use for the storage of surplus honey.

(6) **Using the Division Excluder**:—Confine the queen to a number of combs in the brood chamber with the help of a division-excluder or the queen excluding dummy (page 114), and thus separate out a definite number of grub combs. The bees thus excluded, being queenless, will raise queen cells. After a week, these combs having the queen cells along with some other grub combs of the same colony with the

adhering bees, may be hived separately forming a nucleus, and removed to a new site.

(7) **Another method** :— From the colony to be divided, take out a grub comb with the adhering bees and place it in another brood chamber. Fill up the empty space thus created in the stock with an empty comb and put a queen-excluder on the brood chamber; now put the other brood chamber containing the selected brood-comb on this queen-excluder. Close the hive. The bees in the upper brood chamber, being queenless, will produce queen cells. A week after the grub-comb has been raised to the upper deep chamber, examine the queen cells that are produced, and form a nucleus with that comb along with two or three other grub combs taken out of the brood chamber below. (See 'Raising Queens' in Chapter - 24, and 'Demaree Method' in Chapter - 25).

Separate Shed for Nucleus Hives :—The mating of the virgin queen is a matter of great importance once the colonies are divided to increase their number. It is known that virgin queens, after their wedding flights, sometimes alight on wrong hives by mistake and thereby they either bring their own death or kill the queens of those hives. And if the wrong hives happen to be those from which a large surplus of honey was expected, the loss to the bee-keeper may well be understood and his disquiet may better be imagined than described.

Confusion and mistake often arise on account of the nearness of space when hives are placed very close to each other, and on account of their similarity in

appearance and colour. (See 'Hive Space', page 119). Instead of exposing the honey-yielding colonies, the prospective honey-yielders and the laying queens to such risks, it is advisable to house the nuclei and the queenless stocks in separate sheds in a different environment, at least three hundred feet away from the main yard. It would be better if the sheds could be constructed still further away. And in these sheds the nuclei should be placed, keeping sufficient distance between them, with faces in different directions. Distinctive landmarks should be pitched on the ground in front of the hives so that the virgin queens on going out may take note of the bearings and recognise their own hives when they return from the nuptial flights.

CHAPTER XXIV

QUEEN REARING AND INTRODUCTION

Quite a lot of time can be saved if queen cells are produced early in the spring ready for insertion into the nuclei. For the production of queen cells such a colony should be selected whose queen is in the prime of her age, healthy, has been found to be best from the stand-point of egg-laying, and whose worker progeny is known to be of good temper and a better honey gatherer. The selected colony should be strong, and the work should be taken in hand when nectar is flowing in freely and the drones are on their wings. It is desirable that the virgin queen should mate with a good drone in order to get the best results.

Raising Queens :—For the production of queen cells, remove three grub combs from the selected colony with the adhering bees and place them in a separate brood chamber. See that the queen has not been removed with any of these. Put a queen-excluder on the brood chamber of the stock and place the second chamber over it which contains the three selected combs. Close up the three combs in the upper chamber with a dummy. Close the top. The bees in the upper chamber will build queen cells. Open the hive after a week and examine the combs; destroy the queen cells that are found sealed, and

also those that contain old grubs; keep only those queen cells that are well formed and have fresh grubs (see pages 162 - 163). These cells will be ready for grafting when they are sealed and nearly ripe.

It has been stated before that queens rarely go to the upper chamber. Therefore, in the absence of a queen-excluder (page 112), one may simply raise the combs containing the eggs, and grubs aged not more than three days, in the upper deep chamber and wait for the queen cells. Interposing a queen-excluder between the two chambers is desirable in order to do away with the risk.

Queen cells may be raised by excluding grub combs in the brood chamber by using the division-excluder. (See page 286).

Queens may be reared also in the following way: From the selected colony remove three grub combs with the adhering bees as also the queen; place them in a separate hive and remove the hive to a new site. Now, from the queenless stock take out a grub comb whose cells are full of eggs in the lower part; in order to induce the bees to build queen cells along the edge of the comb, break down the walls of some of the cells containing eggs, to within one-eighth of an inch from the base, thus exposing the eggs contained in such cells. In breaking down the cell-walls, select cells about two inches apart, so that the queen cells when formed may be cut out easily for grafting. Crush the eggs in the intervening cells with the round end of a match-stick or any other similar small stick, and either crush or remove the grubs that may be found

in such cells. This is necessary so that queen cells may not be built out of these intervening cells.

A lot of queen cells can be obtained by the methods as detailed above. (See below 'Queen Rearing on Commercial Scale'). The cells will be ready for distribution as they are sealed and to some extent matured. Nucleus colonies should be prepared and kept ready to receive them at the proper time. A queen cell may be grafted twenty-four hours after the formation of the nucleus.

After meeting the needs of the nuclei the rest of the queen cells in the queenless stock should be destroyed excepting only one or two, so that it may have a new queen. It should be borne in mind that there is every possibility of a very strong stock throwing out a swarm if two queen cells are left. Therefore, keep a close watch on the stock and as soon as one queen has emerged out of a cell, destroy the other, or in the alternative, keep only one ripe queen cell which is considered to be the best and destroy the other.

Introducing Queen Cells :—Queen cells have got to be cut out in order to insert them into nuclei or queenless stocks. Cells should be protected from getting chill and must not be roughly handled. And, in order to graft a queen cell, a grub comb should be selected. (See 'Grafting Queen Cells', page 163).

Ripe Queen Cells :—The colour of the sealed queen cell changes as the occupant within develops and matures. From light yellow the colour at the tip changes into deep brown as the cell becomes fully

ripe when the queen is about to emerge. It has been observed that about four days before the queen emerges, the bees begin to cut the wax that covers the tip of the cell exposing first the light yellow colour. Beginning at the tip they thin out the cell to the extent of about a quarter of an inch in length, finally leaving just a thin film at the tip when the queen is about to emerge. The colour of the tip at the time changes to deep brown.

A ripe queen cell after the emerging out of the queen, will look translucent at the tip when exposed to bright light and seen through. With the queen inside, it is opaque. Should the tip of a ripe cell look translucent before the emerging out of the queen then it must be understood that the queen inside is dead and has shrunk in size. At the time when the queen is about to emerge out of the cell, she will be clearly seen moving round inside it and cutting out the tip. (See 'Queen Grub', page 48).

Emerging of Queen :—The queen emerges from the cell by cutting open the cap like a ring and then pushing her way out. The workers outside, also help the queen in cutting out the cap. That is the usual way how a queen emerges out of a queen cell (page 48). But here is an abnormal procedure when a queen was found liberated from a mature cell :

A colony of Hill-type of bees was divided on the 27th March and a nucleus was formed with three combs. There was only one ripe queen cell in the nucleus on the 5th April, when in the evening it was removed to a different site. On the 6th, the cell was

intact. But on the 9th the cell was found ripped open on its side and was empty. The tip of the cell was carefully examined and found quite intact without a cut or a scratch. This led to one conclusion only—that the queen had been killed in the cell and removed by the workers. But it seemed queer that the bees while eagerly expecting the queen to emerge, should kill her, there being no other cell. A thorough search was made for the queen and to our surprise she was found briskly walking on a comb. She took a long time to mate. Eggs were seen on the 2nd May. The colony was kept under observation. The queen continued to lay, but, in the long run, she did not prove to be satisfactory.

What made the bees rip open the cell and thus release the queen instead of allowing her time to emerge in the usual way by cutting the lid ? It may be guessed that the queen, at the time, was yet weak and not fit to apply herself to cut the lid, and that the workers in their urgency and impatience to get the queen ripped open the cell. But it is difficult to follow why should they not cut out the cap and bring her out. Another probability is that the removal of the nucleus to a new site at a time when the queen was expected to emerge soon was inopportune and some of the bees were annoyed, and in their attempt to kill her ripped open the cell, while others gave her the required protection and thus saved the colony from an imminent danger. A few more abnormalities of the same nature also came to the notice of the author, and in these cases the queens, which were of Plains-type, ultimately proved to be useless.

Queen-rearing on Commercial Scale :—The methods of raising queens as have already been stated are quite sufficient for a queen-breeder not operating on a very large scale. But queens thus raised may fall short of the needs for commercial purposes. Queen-breeding has been specialised nowadays. Queen-breeders now use artificial cells prepared out of wax with the help of special appliances. These cells are then attached to a movable bar that fits in a frame, having about a three inch strip of comb in its upper part or a strip of foundation fixed to the frame, and an arrangement for holding the said bar below the comb or foundation.

Royal-jelly is removed from other queen cells and transferred into those artificial cells with a special tool. Young worker-larvæ are lifted from the cells of stocks occupied by known queens of desirable strain and inserted into those artificial cells. Frames are then given to strong stocks made queenless for the purpose of rearing queens in these special cells. The operations are delicate and they require great care and close attention.

Removing the Queen :—In order to remove the reigning queen of a colony from a comb, the comb in question should be placed in the brood nest in such a way that the queen touches the outer face of another grub comb ; keep only the usual frame-space between them. Now, blow air on the bees that lie in the space between these two combs and the queen will move on to the other. After a minute or two, examine the comb. If she is still found to be on it, blow air on the queen gently and place the comb in the hive as

before and blow air on the bees again. This will make the queen suspicious and she will forthwith leave the comb ; wait a minute and examine it.

The queen may be brushed on to the top bars of the frames with a feather by bringing the comb in question close to the frames. The queen may also be caught by the wings and picked up from the comb and confined in a match-box. The work is delicate and requires careful manipulation. She must not be held by the abdomen. Any injury to the queen caused by mishandling will make her useless.

A simple method of removing the queen from a comb can be employed by taking a half-open empty match-box near the queen and make her step in while she is walking about ; after enclosing her in that half-opened portion, the match-box should be closed gently, keeping only a slight opening for ventilation.

The queen may also be caught in a test-tube, about $\frac{3}{4}$ inch in diameter, by placing its open end over her thus enclosing her inside it and gently pressing down the test-tube on the comb. Now, slowly push in a stiff card (half of an used post card will do) between the comb and the mouth of the tube without injuring the queen and thus closing the mouth completely. Remove the test tube from the comb very carefully with the card on, and reverse it. The card may now be removed and the mouth of the tube be closed with some grass so that the supply of air may not be cut off.

Another method of removing the queen from the comb is to get hold of her with the wet tips of the forefinger and the thumb, for the details of which

see 'Clipping the Queen's Wings', in Chapter - 25. The queen may also be caught in a wire-cage as under.

Encaging the Queen :—To encage the queen, wire-cages may be made in the following ways :

(1) *Circular Queen Cage*—Cut out a disc of wire-gauze, three inches in diameter, having about 16 lines to an inch. Press the edge of the disc and

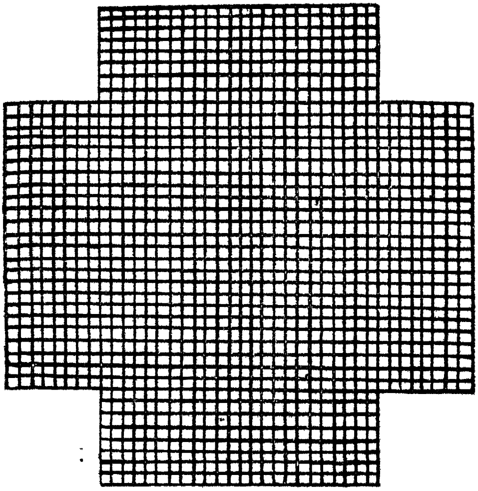


Fig. 72. Making a Queen-cage.
Four corners of the wire-gauze are cut out.

raise the margin making a rim half an inch in depth, leaving a clear two-inch space inside. It will have the shape of a metallic screw-cap of a wide-mouthed bottle. It may also be pressed to the shape of a cup.

(2) *Square Queen Cage*—Take a piece of wire-gauze 3″×3″. From its four corners cut off pieces ½″ square (Fig. 72). Bend the four sides and thus

make the cage (Fig. 73). It will now measure 2" square with the sides ½" deep. Remove two strands of wire from each of the four sides. A cage of this kind can also be made out of a piece of perforated zinc.

The queen can now be easily encaged by placing any of the above cages over her on the comb or allowing her to run into it. A stiff card or a piece of

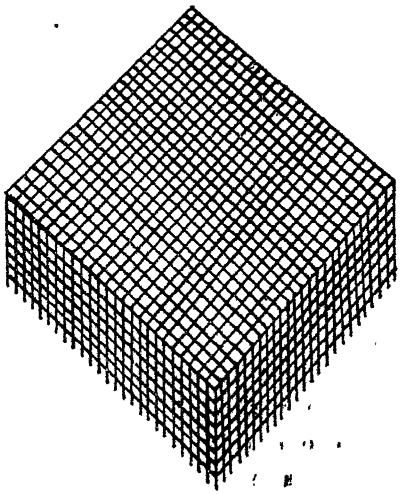


Fig. 73. The square Queen-cage.

pasteboard should then be passed smoothly underneath the cage. The encaged queen can now be removed from the comb. A queen which has been captured in a match-box can be transferred into a wire-cage, if necessary. While encaging a queen in the manner described above, care should be taken not to injure her legs.

Introducing the Queen :—A new queen has got to be introduced into a colony when the reigning queen becomes useless for its purpose. (See 'Queenlessness', page 258). In such a case she must be removed before attempting to introduce a strange queen.

A queenless colony also requires to be re-queened. But one must be sure that a colony is really queenless. When a queen is 'not found' in a hive the absence of eggs must not be taken as the sure proof of the absence of the queen, though one may so conclude. It is known that old queens sometimes stop laying and they may, at that time, evade the searching eyes of the bee-keeper if such colonies be fairly populated. And it is not difficult to understand the kind of reception a new queen will get, if introduced to such a hive, in spite of the precautions taken in introducing her. It is imperative, therefore, to search out and remove the old queen first.

If, at any time of the year, eggs are not found in a colony when others are breeding, and if there is a suspicion of the queen being 'not found' on account of the heavy population, then take out from another colony a brood comb containing eggs and young grubs and introduce it into the colony in question after shaking off the adhering bees. Mark the comb. And if after three days queen cells are found in the marked comb then that gives the unmistakable proof of its queenlessness.

A strange queen is not tolerated by the bees though they may be queenless. Therefore, in introducing a fertile or a virgin queen into a hive,

precautions must be taken and protection given to her, so that she may not be balled and killed. For this the following methods may be adopted :

(1) **Introducing by Queen Cage** :—A new fertile queen can be conveniently introduced into a hive by means of a wire-cage (Fig. 73). The procedure is as follows : Confine the queen in the cage and remove her after closing the open end with a card. (See 'Encaging the Queen', page 296). Take out a grub comb from the hive in which the queen is to be introduced and select a suitable place in it where there are open cells containing honey as also capped brood for the caged queen to occupy. Gently blow off the bees from the selected spot. Now; place there the cage containing the queen ; withdraw the card gently, and press down the cage on the comb and thus fix it there. While so doing, see that the queen is not injured and her legs are not caught between the cage and the comb. Return the comb to the hive and place it in the centre of the brood nest ; close up the combs and put on the top cover. Keep the queen so encaged for at least twenty-four hours, after which examine the cage.

Let us now consider what will happen to the queen on the return of the comb to the colony. Bees will at once rush to the cage in an angry mood, cling to it and press it from all sides in their attempt to ball the queen. But she is safe inside the cage, will get food from the honey-cells, and the bees that will be emerging from the capped brood-cells will also tend her. The queen will acquire the colony-odour as the time goes by during the period of her confinement

and ultimately the bees will be reconciled to the queen. If after the lapse of twenty-four hours it is found on examination that the bees have been reconciled and become friendly with the queen then a few of them will be seen walking on the cage calmy or feeding her through the netting. The queen may then be released in the evening by withdrawing the cage. But if the bees seem to be still hostile and angrily cling to the cage then she should be kept confined for another twenty-four hours. The queen should be released when she has been accepted and the hive left undisturbed for a week, and then examined. If after releasing the queen it is found that she is yet pursued by a few bees and attacked, cage her again and keep her so for two days before she is released next. The colony should be made queenless at least twenty-four hours before a new queen is introduced in the manner described above, and all the queen cells removed.

(2) **Direct Method of Introduction**:—There is also the Simmins method of introducing a new queen by running her directly into the hive on the frames at night. The old queen has got to be removed in the afternoon. The young queen to be introduced should be confined in a match-box in the evening and should be so kept without food and without attendants for half an hour before being introduced into the hive. The match-box may be kept in the shirt or coat-pocket for warmth, if required. Open the queenless hive when it is dark, drive down the bees from the top bars with a puff of smoke, open the match-box upside down over the frames in the centre and allow the

queen to walk down into the brood nest. Close the hive immediately and leave it alone for at least two days. A light may be kept at a distance while so introducing the queen.

(3) Smoking Method of Introduction :—To introduce a queen, prepare the colony in the usual way for receiving smoke, and quilt the frame-tops in the afternoon. Reduce the hive-entrance. (See 'Quilting', page 121, and 'Uniting a Queenless Stock with a Queen-right one', page 248). At dusk, blow three long puffs of smoke at the entrance, allow the roar to subside and again apply two more puffs of smoke. Wait till the buzzing sound ceases, open the top and remove the quilt ; now release the queen, kept confined in the cage or match-box, on the top-bars of the frames in such a way that the queen may run in between the combs and not escape out. Blow a small puff of smoke near the frames as the queen goes down, and close the hive immediately. Leave the hive undisturbed for two days.

Queens by Post :—Fertile young queens can be had of queen-breeders who send them by post in special cages intended both for travelling and introducing, along with about a dozen attendant young workers in each. There is an arrangement in the cage for the supply of soft candy as food to the bees while on transit.

On the arrival of the parcel at its destination, the cover that closes the hole at one end of the cage containing the candy should be removed so as to expose the latter. The cage, with its wire-netting downwards,

should then be placed on the top-bars of the grub combs of the colony for which it is intended, and the hive closed and left undisturbed for at least two days. The bees of the colony will eat away the candy and release the queen who along with the attending workers would by that time acquire the colony-odour. The colony in which the new queen is to be so introduced, should be made queenless just before its introduction, or twenty-four hours before. The introduction of the queen must be carried out according to the instructions of the supplier which accompany each cage despatched by post.

It is a recognised method to send queens by post parcel. Queens so despatched live in the travelling cages in good condition for a long time and arrive safely. But sometimes some queens being unable to withstand the rigours of the journey die in their cages on the way or inside the hive before being liberated by the bees. In this connection it is good to bear in mind that queens and bees of one country may not suit so well another when the climatic conditions are different.

CHAPTER XXV

SWARM AND SWARM CONTROL

The anxious and the impatient cry '*Coo-oo*' of the Indian cuckoo foretells the advent of the spring. The passionate call and the gradual increase of its pitch are maddening. Spring is the breeding time of the birds. When the *cuckoo* cries and the mango-trees blossom early, the bee-keeper must be prepared for one of the most important events of bee-life which is swarming. There is something in the air that makes the bees feel that the time has come. The invigorating atmosphere of the spring, the blossoms, their colour, the fragrance, the nectar, all make them mad. Having got the impulse, they proceed to prepare for the propagation and increase of their race.

A colony cannot exist long without a queen. For, in the absence of egg-laying, there will be no new births, the adult bees will die daily in the usual course, the population will decrease gradually and ultimately the colony will perish. The propagation of their race is an impossibility without the birth of a new queen. But how can a new queen be born in a queen-right colony—one may naturally ask. Is it not a fact that only one queen is tolerated in a hive? Yes, it is so. And it is for this that the reigning queen leaves the old home with a few thousand bees

in quest of a new home far away, and thus makes room for a new queen in the old hive. This issuing out of a batch of bees with a queen is swarming. And without swarming the natural propagation becomes impossible.

The prime swarm takes away a lot of bees from the parent stock along with the reigning old queen. After-swarms then follow one after another headed by virgin queens, and if not checked, this process will continue until further division of the stock becomes an impossibility on account of its population falling off hopelessly. (See 'Honey Season and Swarming', page 187).

There remains always an element of uncertainty on the part of the bees to swarm out in this way, leaving the home behind. It is full of risk. The bees do not know where they will go and whether they will get a suitable shelter. But once the impulse is got, they take wing without the least thought of the future.

Preparation for Swarming:—In a favourable season one may expect, in the Plains, the issuing out of swarms from the third week of February up to the end of the honey-flow. (See 'The Honey Flow', page 205). A colony that grows early in the season rapidly in its natural course, or on account of artificial feeding, will swarm earlier than one that grows slowly. (See 'Feeding for Comb-building and Raising the Population', page 167). Preparatory to swarming out, queen cells are constructed round the edge of the combs; sometimes queen cells are also built on the face. The queen lays fertilised egg in each cell.

The eggs hatch and in due course the cells are sealed and carefully protected by the bees. (See 'Queen Cell', page 45).

The queen lays egg in a queen-cell at her own cost, for, she is creating a rival, though a daughter, and by such laying she is inviting her own expulsion. Yet, the supreme need of the hour urges her and she responds.

Signs of Swarming :—The examination of the hive will show the population to have increased to such an extent as cannot be accommodated inside; there is congestion. The combs will show that practically all the cells are occupied, some with eggs, some with grubs in different stages, some with honey, both open and capped, and some with pollen. (See page 189, last para). Queen cells will be found in different stages beginning with the formation of cups. Some of the cells might have been sealed. Drones will be seen in the hive, and on their wings in the afternoon; they play a great part in the issuing out of a swarm. (See page 50, and also 'Restricting Drone Breeding', page 314).

Notwithstanding the hurry and bustle of the foragers, the keen eyes of the bee-keeper will be able to notice the desultory nature of their work. Groups of bees will be found at the entrance and on the alighting board as if some sort of consultation is going on as to what should be done under the circumstances. A general feeling of uneasiness will be in evidence. The bee-keeper will at once understand what the discussions are about and be sure that

they are bidding time for an opportune moment for the final plunge. It may happen on the very day or may take place in a few days. It may also be delayed on account of bad weather. The measures for the prevention of swarming should have been taken earlier. It should be taken even now.

The Issuing Out of Swarm :—It seems that as the queen-grubs develop, the queen mother feels uneasy and becomes impatient to destroy them. Of course, the queen is not allowed to approach the cells which are carefully guarded and protected by the workers. The queen becomes increasingly impatient as the prospective queens develop inside the cells; the bees also understand that the critical time has come to swarm out. They goad the queen to leave the hive with them. They must get the queen mother with them, for, they seem to know that without her they, by themselves, will serve no useful purpose.

In a favourable weather the swarm may issue out at any time between 9.30 A.M. and 4 P.M. Usually the bees prepare themselves for it from the forenoon to 3 P.M. Confusion prevails in the hive and the bees become restless. They open out the honey cells, fill their honey-sacs with sufficient provision to carry them through for a few days and thus make themselves ready for the journey to a destination which they do not know.

The first indication of swarming out can be detected by the excitement of the bees on the alighting board. Some of the bees walk out hastily through the entrance and they enter the hive again as hastily as

they came out. There is some amount of restlessness. There is a rough buzzing sound inside the hive. The temperature rises abnormally; in a single-walled hive it can be felt by placing the palm of the hand on the hive-wall at the sides.

At the beginning a start is given by a few bees by taking short flights and coming back to the alighting board. Then, there is a small rush in the form of a play-flight, some coming out and some going in. The excitement spreads. The rush increases gradually in volume and soon surpasses the limit and degree of a play-flight. Being pressed from behind, thousands of bees rush out in a thick continuous stream. A booing sound is heard at the entrance. Bees fly this side and that. They spread themselves over the alighting board and crawl up the front wall of the hive. The commotion inside the hive is then distinctly audible. The open space in front of the hive is thickly filled with the flying bees. They whirl round and round as if intoxicated. They go up and down, far and near. Some in their ecstasy will dart high up in the air.

The flight distance increases. Bees begin to hum in frenzy. A mad dance begins, and there is a tremendous humming inviting the queen to join them. When the queen comes out and joins the swarm, the dance becomes rhythmic. A thrill seems to pass through the whole swarm of bees. They understand the presence of the queen. They dance in joy, they swim in the air gaily and the movement of their wings seems to raise ripplets.

Slowly they move away and are finally cut off from the front of the hive. They fly on to find a support. They close up the circle of flight and search for a shelter to take rest, ultimately settling on the branch of the nearest tree, a corner of a building or any other suitable place. Bees generally settle down forming a single compact cluster, but sometimes they form separate clusters at close quarters on the same object, and soon unite forming a single mass (page 138). They wait silently till the scout-bees return and show them the way to their new abode.

Some drones will be found in the cluster. A few foragers may also be seen with pollen in their hind legs. These pollen gatherers must have been drawn into the whirl on entering the hive or while on their wings near the hive when the swarm came out.

The Unwilling Queen :—If the queen fails to come out at the first start, several attempts may be made by the bees in a day for swarming out. The start that becomes ineffective may be called a false start; in order to be effective they must have the queen with them. The unwilling queen may refuse to join the swarm. In that case, after whirling for sometime and waiting for the queen, the bees return to the hive. They may even cluster without the queen, but they are sure to come back soon. They goad the queen and start again, thus there may have several starts in a day at short or long intervals.

Sometimes a queen may be seen to come out on the alighting board and enter the hive hurriedly. She may be doing this several times. She may be unwilling to

leave the home and may not gather sufficient courage for the flight. But the inevitable happens, the pressure of the bees becomes irresistible and ultimately the queen submits. She comes out and swims with the swarm. Yet, some timid queens were seen by the author to have come back with the swarm and clustered on the front ventilators or on the side-walls of their hives. (Fig. 74). Such clusters break up soon

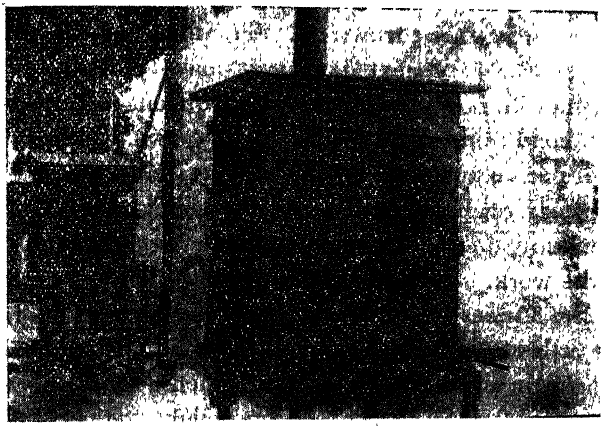


Fig. 74. A swarm that returned and clustered on the side-wall of the hive.

and the bees either take wing along with the queen and fly away, or crawl down into the hive and rush out again after a few hours for the final start or wait till the next forenoon.

The Parent Colony :—When a swarm has been thrown out of a hive the parent colony shows all the signs of queenlessness. The bees become indifferent and the hive looks desolate. Some of the bees settle on

the front wall of the hive, and some of them cover the alighting board and cluster at the entrance. Slowly they break away, and by the evening everything settles down, if not earlier. The hive contains queen cells in different stages, some of which might be mature. Bees wait patiently for the virgin queen to emerge. A virgin may even be found on the very day the prime swarm issues out, both before and after.

The Cast :—After the issuing out of the prime swarm, casts are thrown off. The first cast may come out on the very next day, or it may be delayed. It depends on how quickly the virgin queens emerge and the condition of the stock (page 188). When the bees decide not to throw any further cast, they allow the last virgin queen, then emerged, to destroy the remaining queens in the cells. The bees also help her in the work.

Sometimes two or more virgin queens emerge from the cells at one and the same time and thus more than one virgin accompany a cast. In such a case, only one queen is allowed by the bees to head a colony. The author had seen three queens in a cast, issued out of an uncontrolled colony. While the cast was still clinging on to a branch, two of the queens were seen to be pursued by the bees, caught and maimed and thrown down. Sometimes two queens accompany a swarm and they both occupy a new abode, but there they fight out and the weakest of them succumbs.

Swarms Uniting in Air :—Sometimes swarms issue from more than one hive at one and the same time. While circling round the yard two or more

swarms may unite in the air. They may divide themselves again and fly away in different directions. On one occasion we have seen two swarms which after uniting in the air and flying hither and thither for about a quarter of an hour separated again into two. One of them made off and was lost, and the other after much hesitation and reluctance returned slowly. It approached one of the hives from which the swarms had issued, and began to enter it. The bees of the hive rushed out and spread themselves on the alighting board in a threatening attitude. There was some resistance and fighting, and then they yielded. But when the queen alighted she was first attacked by a couple of bees. She at once took wing and after circling round, came down again on the alighting board and was balled immediately. In all probability it was the queen of the other colony that found herself mixed up with the main bulk of the bees ; and it was merely a chance that she was drawn into the group of bees that returned and, therefore, had to alight on the wrong hive with the result that she was balled.

Helping Bees to Cluster :—As soon as the swarm has been cut off from the hive, spray water on the bees with the help of a hand sprayer. This will induce the bees to settle close by and settle soon, otherwise the swarm may go far away and cluster in an inconvenient position. And when the bees have once settled in a cluster, spray them again so that they may form a compact mass. This will be helpful in the subsequent handling of the bees in order to secure the cluster (page 133).

Other Swarms:— Sometimes bees abandon the hive and come out like a swarm. This is decamping. It may be caused by starvation, robbing and the ravages of wax-moth caterpillars. It may also be caused by discomfort on account of exposure to sun and rain (pages 118-119), and bad odour. This may happen at any time of the year.

Sometimes bees decamp following a virgin queen when she comes out on a mating flight, leaving in the hive only the young bees that cannot fly. It has also been noticed that sometimes a large number of bees accompany a virgin queen on her mating flight and settle close by like a swarm, along with the queen ; they leave behind about half the population in the colony.

Causes of Natural Swarming:—It is generally believed that the principal causes of swarming are—(1) overcrowding and cramping of bees in a small space in the brood chamber, and (2) the rise of temperature in the hive on account of such overcrowding. Of course, when these happen, the relief lies in (i) removing the congestion of the brood nest by providing fresh frames having drawn combs or foundation, thus giving them more breeding room, and (ii) opening the hive-door to its full width and also opening the bottom-board ventilator, thus admitting more air. We ourselves require more air in a congested room, and we require more room for a congested family. The bees when similarly placed also require these two things. These are bare necessities and must be attended to. Lack of breeding room is a

great impediment when a colony wants further room for expansion.

But these two alone cannot prevent natural swarming, for, in spite of these two measures being taken, the bees prepare queen cells. Adequate supply of space and proper ventilation can only defer their tendency to some extent, but their hunger for the propagation of race that makes them throw off the swarm, still remains. It is an unalterable law of nature. It occurs quite independently, irrespective of the population of the colony or congestion.

Prevention of Swarming :—The methods of control and prevention of swarming have been diligently searched for and experimented upon by the bee-keepers ever since artificial bee-keeping has been taken in hand. By adopting various measures one can prevent it completely, and the task becomes easy as experience is gained. Under modern methods of bee-keeping, the bee-keeper by comparing the records of his colony and examining the brood nest can determine correctly when the swarm may be expected. (For, 'Keeping Record', see Chapter-26). He can, therefore, take steps in time and set himself to prevent it. The measures are described below.

Providing sufficient breeding room and full ventilation :—When the requirements of the bees relating to their breeding facility and ventilation have been attended to by giving them the full complement of frames having drawn combs or foundation, and opening fully the hive-entrance as also the bottom-board ventilator, the undernoted measures should be

taken in hand. (See 'Causes of Natural Swarming', page 312). It should be borne in mind that the brood may be exposed to chill if the bottom-board ventilator remains open during chilly and cold nights. It would be better, therefore, to keep it closed during the night and open it during the day. In the summer there will be no harm if it remains open at night, rather, it will be helpful. The measures referred to are—

(1) **Early supering** :— Shallow frames having drawn combs or fitted with foundation should be arranged in the super in advance of the requirements of the bees so that they may get plenty of room for the storage of nectar as soon as the flow begins. (See 'Supering', page 190).

(2) **Restricting drone breeding** :—Drone breeding should be limited to a minimum. The presence of a large number of drones in a hive encourages swarming. They continually impress on the workers that the swarming time has come. Their presence urges the workers to rear queens. Then again, the drone grubs occupy a lot of space which might have been well occupied by the worker grubs. Time, labour and food are being wasted in rearing an excess of drones which might have been otherwise utilised in rearing the workers. Therefore, an excess of drone breeding must be checked by cutting out those portions of the combs which contain the unnecessary drone cells even if they contain eggs and grubs. (See 'Drone Cell', page 44, and 'Capping of Cells', page 54). Also cut and remove all the patches of capped drone-brood that are not required.

(3) **Removing brood combs** :—When a hive contains frames to its full capacity and it is found that the brood nest is congested, relieve such congestion by removing one or two grub combs and fill up the empty space with frames having drawn combs or foundation. The grub combs that are removed should be given to weaker colonies.

(4) **Extracting honey** :—Extract honey regularly every week or as soon as the combs are full and capped, so that the bees may not be handicapped on account of the shortage of storing room. The side-combs of the brood chamber containing honey in a Newton hive (page 192) may be extracted to relieve the congestion if required. (See 'Standard-frame Hives and Supering', page 196, also 'Extraction of Honey', page 210).

(5) **Cutting out queen cells** :—Bees do not swarm unless they are sure of the possibility of a new queen being born to head the parent stock, and as a provision for that they start queen cells. Therefore, as a preventive measure cut out all the queen cells as they are started and built. (See 'Removing Queen Cells', page 194). Bees build fresh cells as soon as these are destroyed, and they go on continually building such cells. Therefore, these cells should all be cut out regularly on every seventh day throughout the swarming period. Conjoined with the other precautionary measures stated above the destruction of the queen cells gives full satisfaction in the prevention of swarming, though it takes a little time and requires some amount of labour and patience. In breaking down the queen cells the combs must be thoroughly

examined because the bees are sure to throw off a swarm if, due to oversight, a single cell be left out.

That queens sometimes play hide-and-seek and evade the eyes of the bee-keeper at the time of the examination of the comb, has been said before. During a certain swarming season how a queen had stopped laying eggs and by this dodge put the author in the wrong track will now be told. The colony in question which was examined last on the 8th December was next examined on the 29th January when queen cells were found in five of its combs. There were eggs in the queen cells. The queen was found, and all the queen cells were cut out.

On the 5th February the hive was again examined. The bees were restless and not working. Queen cells were found in seven combs. These cells contained fresh grubs. The combs were all examined three times and nowhere could the queen be found. There were no eggs in any comb though there were plenty of empty worker cells. Some of the worker cells had freshly hatched grubs. On account of the absence of eggs and on account of the queen being 'not found', she was taken to be lost. Therefore, to re-queen the colony, one queen cell was kept and the rest were broken down. (Let the reader note here that the first trick of the queen in not laying eggs had been successfully played by her).

On the 7th February the hive was again examined. Fresh queen cells were found ; these were being built during the last two days. On close examination, eggs were seen in some of the worker cells of a comb

on both sides at the bottom. The presence of eggs indicated the presence of the queen though she was not found, and, therefore, all the queen cells were removed including the one that had been left on the 5th.

The hive was next examined after a week on the 14th February. This time too the queen was not found. There were a lot of queen cells containing grubs, some of which were sealed. But no egg could be found in any queen cell or in any worker cell. So, all the queen cells were destroyed except one for queen rearing. (The dodge of the queen for the second time should be noted).

Next day, on the 15th at 1.30 P. M. bees swarmed out; but they returned immediately and settled on the front ventilator of the hive. The queen's 'p-e-e-p' was heard in the cluster. She was piping in rage, her rival being the prospective queen in the single sealed cell that was left in the hive on the day before. The day was sunny and the temperature was 30·5° C. at noon.

Apparently the queen was timid and so the swarm had to come back, and the bees were in no mood to re-enter the hive, and they clustered at the ventilator along with the queen. But how strangely had the queen thwarted the bee-keeper !

The swarm was hived separately and removed to a new site. The stock was examined at 3 P. M. The sealed queen cell was seen intact, but there were several fresh queen cells which must have been built overnight, and it is to be noted that all the queen

cells contained eggs. The colony had eleven British standard frames at the time.

The prime swarm took away about 12,000 bees. It reduced the numerical strength of the stock to a great extent. In due course the virgin queen emerged and mated, and began to lay. Precious time was lost in the meantime, and by the time the young bees began to emerge from the fresh lot of eggs and took their work as foragers, a good many old bees died. Yet, the colony yielded 21 lbs. of honey for the season.

Spraying water :—In order to check the immediate issue of a swarm when the bees have just started to come out, spraying water inside the hive through the entrance and the ventilators, and on the bees that are on their wings near the hive, will have a temporary effect; it will also cool down the bees and lower the hive temperature. It should not be overdone as that would affect the young brood. A second or a third start might not be averted by spraying water, for, the rush will be so great that no amount of spraying will be able to check it. They will simply force their way and dart out in the air with great vigour. When the swarm has been cut off from the hive, the spraying of water on the bees will induce them to settle quickly on the nearest shelter. (See 'Helping Bees to Cluster', page 311).

Clipping the queen's wings :—The clipping of the wings of the queen is practised in every country. It is best done early in the season when the population has not increased much. In order to clip the wings proceed as under :

Take out the comb that has the queen, and suspend it on a frame-stand. With the wet tips of the forefinger and thumb of the right hand and approaching her from the rear, pick up the queen by her wings gently. Then take her in the left hand by holding the thorax with the forefinger and the thumb of the left hand. Now, cut about half of the two wings of one side with a pair of small sharp-pointed fine scissors. Return her to the hive over the top-bars of the frames so that she may run in. The wings of both the sides may thus be clipped.

The operation is delicate and should be done with the utmost care so that her abdomen may not be squeezed or pressed in handling. To avoid the risk of her taking flight the beginner may first encage her, remove her from the comb and then perform the operation inside a mosquito-curtain. (See 'Removing the Queen', page 294).

The wings may also be clipped for recording the age of the queen by cutting the wings of one side in the first year and the other side in the next year. The virgin queen should never be clipped.

In the matter of controlling swarming, the clipping of the wings can only prevent the queen from taking flight with the swarm. The idea is that with the wings clipped, the queen will not be able to fly away. But all the same, it cannot prevent the issue of a swarm. In the event of a swarm coming out, the queen, being unable to fly, is sure to fall to the ground in front of the hive. The swarm may finally cluster close by, but having lost the queen, will

return to the hive. In the meantime, on a search being made, the queen will be found on the ground surrounded by a few bees who might have noticed her drop down, and clustered round her; this is because they cannot fly away leaving the queen alone in that helpless condition.

In such an event the queen should be picked up. The hive should then be opened, the combs examined and all the queen cells broken down. The queen may now be allowed to run into the brood nest over the top-bars of the frames or may be released at the hive-entrance. But there is every probability of a clipped queen being lost when a swarm comes out unnoticed. While on the ground she may be attacked by ants, spiders and other enemies, or she may crawl away and thus be lost. The apiarist himself may unknowingly trample her down and thus kill her.

It is only the trouble in following and securing a swarm that can be saved by clipping the wings thus. But the finding out of a clipped queen on the ground presupposes a constant watch on the hive, for, there is no knowing exactly when the colony is going to throw off a swarm. Then again, the difficulty will not be solved merely by picking up the lost queen only once. For, there will be the next lot of queen cells, and if the bee-keeper fails to destroy the cells in time, the bees will again swarm out and the queen will drop down to the ground, and this will continue. To avoid this, the only course open to him is to remove the stock to another site as soon as the swarm is out, and place a newly-prepared hive in its place, and when the

swarm returns and enters the new hive, to allow the picked up queen to run in with the bees. The swarm will thus be housed in a new hive in the old place. And for all practical purposes this is only hiving the swarm separately ; it is the same thing as dividing a colony and increasing the number. To achieve this result there is absolutely no reason why a queen's wings should be clipped, for, there are other methods of dividing a colony which the bee-keeper can adopt according to his own convenience and requirement. (See Chapter - 23).

Wing Clipping : *An old practice in India* : The clipping of the wings of the queen has been known in India from very early days. In Watt's "Commercial Products of India" we find on the subject—"Bees"—that prevention of swarming was effected in the old days by giving each colony ample room, and "sometimes by clipping the wings of the queen".

Dividing the colony :—This is an approved method for the prevention of swarming. From the stand-point of a colony in its entirety, the act of dividing it has practically the same effect as it would have by swarming. But the difference is that whereas swarming is *natural*, the division is *artificial* and that the bee-keeper gets all the advantages that artificial division can bring him. Artificial swarming is always better than natural swarming. (For the various methods of dividing a colony, see Chapter - 23, page 281).

De-queening :—De-queening a colony as a measure for the prevention of swarming is recommended by some bee-keepers. By this method the reigning queen has got to be removed from the hive just at the

opening of the swarming season and the colony kept queenless for about two weeks. After the removal of the queen, the queen cells that will be formed should all have to be cut out once at the start, and then on the fifth or the sixth day, and again by about the tenth day. As there will be no queen to lay eggs and no queen cells for rearing a new queen, the bees cannot swarm. By the end of the second week a new fertile queen should be introduced, or a grub comb given to the bees for queen rearing.

But the hive cannot be kept queenless for a long time, for, the laying workers will create trouble. And if the bees are already in a mood to swarm out, and had built queen cells before de-queening, then there is the probability of a swarm being thrown out after a fertile queen is introduced or when a new queen is reared and she is laying eggs.

An interruption in the egg laying of the queen at a time when enough field force has been developed and the super is being worked, can be effected by confining the queen in a wire-cage on one of the combs thus preventing her from laying eggs. The same purpose can also be achieved by removing the queen to a nucleus hive. The queen cells in the parent hive should all have to be destroyed at the beginning, and then by the fifth or the sixth day after the removal of the queen, and again by about the tenth day. The reigning queen may then be returned to the colony. This interruption in egg laying stops the emergence of young bees for a limited period, and thereby it helps to avoid overcrowding.

Eliminating the swarming tendency :—Another method for the prevention of swarming is to eliminate the swarming tendency by breeding it out. It can be done by breeding queens only from those stocks which to a great extent restrict the breeding of drones and show a non-swarming tendency, for, careful observation will disclose that there are stocks which are less inclined to swarming than others. It requires continual selection of both queens and drones.

Other Methods of Prevention :—It is held that the desire for swarming is roused by the abnormal increase of nurse bees when the queen has passed the highest period of her egg-laying, and consequently by an excess of larval food. (See below, 'Mr. Morland on Swarming'). Another theory is that swarming is caused by the presence of an excess of young bees reaching the stages of wax-secreting, comb-building and honey-ripening, and for whom there is no sufficient work. The suggested remedy is the removal of these bees from the brood nest. Taking both the theories together, what eventually comes to is to separate the young bees from the adult bees, that is to separate the nurse and the wax-secreting bees from the foragers. This ultimately comes to separating the queen from the young bees and the main bulk of the combs containing the brood. This may be effected by manipulating and re-arranging the brood combs and the brood chamber.

Demaree Method :—The method devised by Mr. Demaree of the U. S. A. in 1892 is one of the most popular methods of controlling swarming. Demareeing is doubling the brood chamber. When the brood

chamber of a colony begins to be crowded on the approach of the swarming time, find out the queen and remove the comb containing her and place it in a separate hive in the centre of the brood chamber. It is essential that the comb so removed should contain young brood. Queen cells, if found in the said comb, should all be destroyed; and the comb should now be closed up with as many empty combs or frames with foundation as there are combs in the stock. Put a queen excluder over the brood chamber of the new hive; remove the old hive aside, and place the new hive containing the queen, on the old stand. Now, lift the original brood chamber with its combs along with the adhering bees and place the same on the excluder of the new hive. Examine all the combs now in the upper brood chamber and destroy the queen cells if found.

The bees from the field will come and join the queen in the lower brood chamber. The flying bees of the upper chamber will also join the queen below. The queen and the old bees will now find themselves in the position of a swarm, housed in a new hive. It is in effect an artificial swarm which has been housed in the same hive along with the queenless stock but in two separate chambers one above the other, with a queen excluder interposed between them. It has this great advantage that the population of a colony does not require to be divided as it would have been by an artificial division. The queen in the lower chamber having got ample breeding room and one brood comb as a bait, will go on laying uninterruptedly. It will

now be noticed that by the Demaree method the queen is separated from the main bulk of the brood and the nurse bees as a means of controlling swarming, referred to above in the 'Other Methods of Prevention'.

The bees in the upper storey finding themselves queenless, will build queen cells. Seven days after, examine the top chamber carefully and destroy all the queen cells. Examine also the combs in the lower chamber and cut out the queen cells if any. As the brood in the upper storey will hatch out, the empty cells, it is to be expected, will be filled with nectar.

Overcrowding soon occurs in the lower brood chamber of a Newton hive having seven frames when thus Demareed. But the bees must not be allowed to raise another queen, and to this end the brood combs must be examined every week and the queen cells destroyed.

It has been found by the author that the deep combs placed in the upper storey of a Newton hive are not filled with nectar as easily and quickly as shallow combs are filled. Bees are reluctant to store honey in the deep supers. Therefore, in the Plains, it is better to extract the deep combs of the upper storey as soon as the last batch of bees emerges out, and replace them by shallow combs placed in a shallow chamber.

Mr. Morland on Swarming :—At a meeting of the Royal Society of Arts held on the 19th January, 1938, Mr. D. M. T. Morland read a paper on "Recent Investigations into Bee-keeping at Rothamsted" which was published in the *Journal* of the Society, dated London, the 11th March, 1938, (page 394). He dealt

with various matters on bees. As to the causes which lead the bees to swarm Mr. Morland said that the old Brood Food Theory on swarming had been re-examined at Rothamsted Experimental Station from the point of view of the work done by Dr. Rosch of Germany, on the division of labour in the bee colony. He also confirmed in the main Dr. Rosch's observations, but he found that the bees sometimes undertook duties at an earlier age than that given by Rosch.

Mr. Morland's experiments gave proof in support of the brood-food theory. (See 'Other Methods of Prevention'). He found that on the whole there was a tendency for the older and younger bees to stay in the parent colony, while the middle-aged bees of a fortnight to three weeks old swarmed out with the old queen.

Mr. Morland also referred to the Snelgrove system of preventing swarm, based on the facts as stated above, and said that it had been tried at the experimental apiary and the truth of its assumptions tested by means of marked bees.

Snelgrove Method :—In the Snelgrove method of swarm control the *functions of young bees* play a significant part. So, first of all, let us discern the duties of the bees inside the hive.

Bees start their life with work for the colony, and as they advance in age, they take up different duties within the hive, which cover a period of about three weeks, till they grow strong enough to undertake field work. From observations it has been found that for the first three days they clean up the empty brood cells and make them ready for the queen to

lay eggs, and in a way they also help in maintaining the hive temperature. For the next ten days they keep themselves engaged in nursing the larvae, to be more accurate, from the third to the sixth day they feed the older larvae with bee-bread (see page 50), and from the sixth to about the thirteenth day they feed the younger larvae with royal jelly. And for the next seven days, i.e. from the thirteenth to about the twentieth day they attend other works of the hive which include honey ripening and secretion of wax. The field work begins sometime during the latter part of the last period, but no line of demarcation can be drawn as to where the wax-secreting stage ends and the field work begins, for they overlap.

The method of swarm control devised by Mr. L. E. Snelgrove is based upon this conception of the division of work of the bees and upon the supposition that it is the nurse bees present in a colony in large numbers which induce the swarming impulse due to a surplus of the special brood-food, royal jelly. (See 'Other Methods of Prevention', page 323). Thus, here the main plan of control lies in separating the nurse bees from the flying bees within the hive, and this is being done with the help of a control-board ingeniously devised by him. To bring the control-board in operation, the brood combs have got to be re-arranged in a particular way in two or more brood chambers as might be necessary. The method claims to control swarming without the bee-keeper himself destroying the queen cells, the work being left to the bees. For the detailed description in working out the method the reader is

referred to his book named "Swarming: Its Control and Prevention".

A very strong colony is necessary for the application of the Snelgrove method. A colony to be in an ideal condition for the plan to be worked upon should occupy two brood chambers having brood frames of British standard size, supered above with shallow frames over an excluder. Here in India, in the Plains, it is not possible to make a colony as strong as that. We may not expect a stronger colony than one consisting of twelve British standard frames in one chamber, for, as soon as a brood comb is raised to an upper chamber, we get queen cells without even interposing an excluder. Apparently it is not possible to get the queen to lay eggs in two brood chambers simultaneously. And then it is also difficult to make the bees work in the supers of hives having bigger frames (page 196). But this method of control is well worth trying in the hill-districts as bigger frames are in use there.

Early and Late Swarms:—It has been stated before that stimulative feeding in advance of the honey flow season brings early the normal swarming fever. (See 'Feeding for Comb-building and Raising Population', page 167). By adopting such feeding in advance of the season in our apiary, queen cells were found in some of the colonies of Hill-type bees in the first week of December; the cells contained eggs and grubs. Queen cells were also found in January. With this type of bees we find queen cells in November too without taking recourse to feeding.

Weak colonies often prepare for swarming, late in the season, after they have become sufficiently strong. Queen cells built after the honey flow season are usually broken down by the bees themselves. Sometimes swarming cells are found in some of the colonies of the Plains type of bees as late as the end of June; virgin queens also mate though they emerge so late. Swarms thrown out late may be hived in the usual way, but should be fed artificially so that they may build up quickly.

Bee Atmosphere :—The typical atmosphere of the apiary attracts bees from outside. In one year we had as many as four wild swarms of Indian Bees that clustered in the bee-yard. Of these, three swarms entered consecutively on the 5th, 12th and 17th July. These were late swarms, and one had a virgin queen. The fourth came on the 11th August, and in all probability it was a case of decamping due to hunger, commonly known as 'hunger swarm'. Scout-bees were noticed on each occasion before the swarms appeared, and they all came in the hope of getting shelter.

The following account of a stray swarm of rock bees that behaved in an unusual way will be interesting. Sometime in the earlier part of July, at about 3 P. M., attention was drawn by a distant but a very vigorous humming which came near fast. It was a swarm of rock bees flying away at a tremendous speed and, on its journey, was crossing our bee-yard high up in the air. In the twinkling of an eye the swarm was over our head, and crossed the yard. It appeared that at the next moment it would be out of sight. But the

swarm behaved strangely. It seemed that they had met with an obstruction, as if they had been thrown against a net laid across their track. They fumbled. Their onward journey stopped suddenly, and slowly they descended. There was an effort to settle down immediately. They scattered themselves into several groups in search of a suitable place and ultimately settled in a cluster on the branch of a kapok-tree that

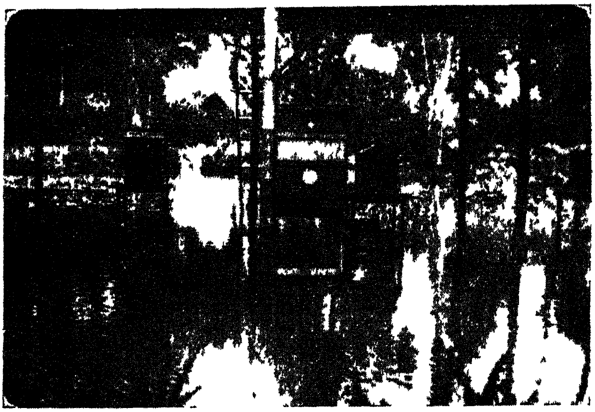


Fig. 75.
Sodepur Apiary : Bee-yard under water in August, 1939.

stood close by. Unmistakably it was the bee-atmosphere that made the swarm stop abruptly and settle down.

It was then a slack season and a rainy season too. There was incessant rain for eight days at a stretch between the 27th July and 3rd August. The downpours were heavy. Our bee-yard was under knee-deep water (Fig. 75). We had sunshine on the 4th, and the swarm decamped a day after.

CHAPTER XXVI

KEEPING RECORD : READING BOOKS

Keeping Record :—It is necessary to keep record and detailed notes of every colony in the apiary. No thorough study of a colony is possible without it when the improvement of the strain is intended. And one cannot do without keeping detailed notes when queens are being reared in the nucleus hives.

Colonies should be numbered serially and a register kept. Notes must be kept about the internal condition of each colony, about the swarming propensity, the honey yield, the age of the queen and her egg laying, the behaviour of the bees, the stored food and feeding, the cleanliness of the hive, any abnormality and, in fact, every thing that may be observed during each examination. These notes will guide the bee-keeper to do what is necessary for the colony, and while opening it for the next examination this note will be of great help as it would give a correct picture of what was seen and done last. Comparative studies of the progress of work in a colony are of great importance, and it must be understood that every colony has got its own tale. A book for recording the day's work and a hive register are, therefore, indispensable.

Reading Bee-literature :—One should acquire the habit of reading bee-books and refer to them whenever

there is any difficulty. One or two reliable books at the beginning will be quite good to know and to practise the art. And as one acquires experience by practical work, one may go in for more books.

There are many publications on bee-keeping, both Indian and foreign. It is advisable to acquaint oneself with others' experience and know what is done elsewhere and how it is done. The bee-books are a mine of information and every author has his own experience to tell. (See 'Bibliography' at the end of the book).

Then, there are the bee-journals which contain articles contributed by bee-keepers, and there are also questions relating to bees and bee-keeping answered by the editors. They are a great source of information, and they have their educative value too. Of the foreign periodicals, the names of *The British Bee Journal*, London; *The American Bee Journal*, Hamilton, Illinois, U. S. A., and *Gleanings in Bee Culture*, by the A. I. Root Company, Medina, Ohio, U. S. A., may be mentioned.

In India, we have *The Indian Bee Journal*, published by the All-India Bee-keepers' Association so long from Jeolikote, district Naini Tal, U. P., the office of which has now been removed to Ramgarh (Naini Tal) about 17 miles from Jeolikote.

CHAPTER XXVII

STORAGE AND RETAIL PACKAGE OF HONEY

Storage :— The extracted honey may be suitably stored in bulk in four-gallon square or round tin-cans, and the caps pressed down to keep the honey air-tight, until taken out to be packed into retail containers. The honey should be kept in a cool dry place. Moisture and moist places must be avoided. (For 'Straining and Blending Honey', see page 228).

Four-gallon *new* tin-cans can be obtained from the manufacturers of tinplate hollow-wares, as these are extensively used for storing and transporting oil, *Ghee* and similar substances.

There is every risk of the honey acquiring an unpleasant odour when stocked in second-hand tins that had been in use for storing other materials, unless they are very carefully cleansed and thoroughly dried in the sun before being used. Soda, *Sajimati* (Fuller's Earth), lime and hot water may be used to cleanse these tins. Rusty tins must never be used.

Retail Package :—Light or deep, whatever the colour of honey may be, it should be good and have a delicious flavour. It should be clean and transparent. It must not contain any suspended matter. It must

be free from scum and must not show any sign of fermentation.

Honey should be offered for sale in an attractive way. It may be packed for retail sale in one-pound screw-capped glass jars as are generally used for preserved fruits, jams and jellies. It may also be packed in wide-mouthed bottles.

The colour of glass should be white, free from any tint, whether greenish or any other tinge. Bottles and corks should be thoroughly washed with clean water and dried. Hot water is preferable. One should see that the containers are spotlessly clean before they are filled.

The wadding of the screw-cap should be covered over with a piece of grease-proof paper of the same size as the wadding. Wide-mouthed glass bottles when used must be corked air-tight. The cork should be covered with grease-proof paper in order to prevent it from coming in contact directly with honey so that the latter may not leak out through any minute hole in the cork.

When the bottles are filled with honey and properly corked, their necks should be dipped in melted hard-paraffin one by one, and then labelled. Glass bottles and jars are best for retail package as the colour of honey can be seen through them, and in this way they help to attract the eyes of the purchasers.

Honey may also be packed in screw-capped tin-cans lacquered inside. They may have lever-lids, or any other suitable lids that may be soldered

afterwards. It is well to remember that honey darkens in colour very slowly when stored or packed in unlacquered tins.

Labelling :—The container should have a good-looking label of proper size, neatly pasted with

Fig. 76. Honey Label.

clean adhesive. They may have artistic designs, printed neatly on coloured papers of different shades, in order to match the colour of honey contained in the bottles.

The container after being labelled, should be wrapped up with oil-paper or any other transparent paper to keep it clean and the label unsoiled. The colour of honey could be easily seen through the oil-paper. The sheets of both the grease-proof and oil-papers measure $30'' \times 20''$.

Marketing :—In the matter of marketing honey, its quality, the quantity produced and the existing demand should have to be taken into consideration. The possibilities of the expansion of markets and making bottled honey easily available to the con-

Fig. 77. Honey Label.

sumers, must also be taken into account. Organised marketing enables the producers to dispose of their products with advantage. In the absence of organised bee-keeping in the country at the present moment, individual producers must arrange the disposal of their goods by retailing out direct to the consumers. Co-operative societies of bee-keepers may be formed both for the spread of modern bee-keeping and marketing honey. The help of large individual producers as also reliable organisations, firms and agents may be sought for in the disposal of the stocks.

As the number of bee-keepers will go on increasing, it may be expected that village and district bee-keepers' associations will be formed to be co-ordinated by a central provincial organisation. The work of the district and the provincial associations would generally be to look after the interests of the bee-keepers, help them with technical advice, carry propaganda to stimulate the consumption of honey, assist the members to dispose of their produce, organise demonstrations, arrange lectures with the help of lantern-slides and cinema-films on bees, bee-keeping and uses of honey, and render service in a number of ways. These associations may not take up the actual trading work.

Regarding cinema-films it may be mentioned that moving pictures on bee-life and apiculture have been produced by Mr. Manomohan Choudhuri at Bari (district Cuttack, Orissa) where the Gandhi Seva Sangh has a Village Reconstruction Centre and an apiary attached to it. The film is of 16 millimeter size and can be shown by means of an electric projector. It is approximately 500 feet long, and takes about twenty minutes to screen; the time can be prolonged by talks on individual pictures and subjects.

We had occasion to see the pictures at Sodepur. The film embraced pictures on the anatomy of the bee, the development of the brood, comb-building, the work inside the hive, the dance of the bee, collection of nectar and pollen, and then the various parts of the hive, hiving a wild colony, the examination of a colony, the extractor and the extraction of honey.

In fact, the pictures gave full details of modern bee-keeping, and the film was highly interesting.

Sale Price :—According to the country of origin the imported honey was sold in India at prices varying from Rs. 1/2 to Rs. 2/4 per lb. in one-pound bottles and jars, prior to the second World War in 1939. Dealers in provisions and stores stock and sell honey. The producer here may ascertain the retail market price of the foreign honey and fix his own price.

On account of the abnormal rise of the price of jars, bottles, corks and paper due to war, and on account of the high manufacturing cost of hives and appliances, and on account of the rapid and abnormal rise in living cost, the price of Indian honey has gone up like that of other commodities. It now sells at prices varying between Rs. 3/- and Rs. 3/8 per pound. But the price is sure to come down when normal conditions return.

Exhibiting Honey :—Extracted honey, both liquid and granulated, may be exhibited in glass jars or bottles. If desired, the various colours of honey may be displayed by arranging the samples according to their shades from lighter to deeper.

During the flow season, sealed honey in shallow combs with white cappings, as also uncapped honey, may be displayed in small and handy glass cases. It will enable a visitor to understand how the bees seal the cells when the honey is ripe. These combs of honey make a beautiful show (Fig. 78).

The sealed combs of honey may be kept exposed for display at best upto May in the Plains. As the

rainy season sets in, honey in the cells absorbs moisture from the air, increases in volume and the combs begin to 'weep'. The honey trickles down

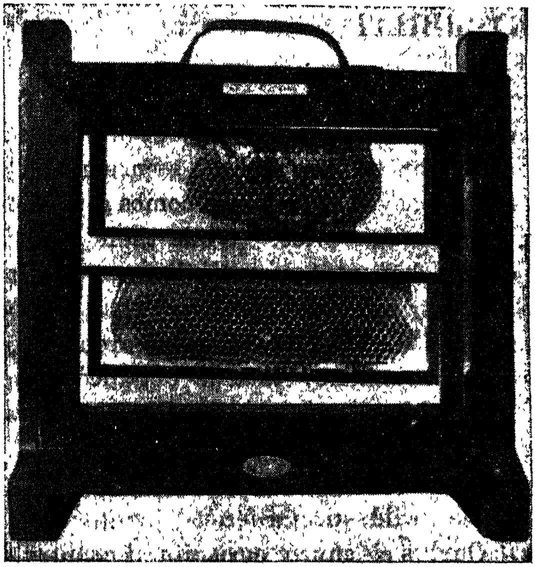


Fig. 78. Show Case.
For two Shallow Combs or one Brood Comb of Newton size.

the combs. It exudes in droplets through the cappings and makes the appearance ugly. The glass case should be removed from view before that happens.

CHAPTER XXVIII

POSSIBILITIES OF BEE-KEEPING IN INDIA

The bee-hunters obtain honey out of wild colonies. They get it for the trouble of securing the combs. Apart from honey, the squeezed combs give them wax which fetches a fair price. While there is no export trade of the honey thus got, the wax has a ready market. This squeezed-out honey has neither the keeping quality, nor the flavour, aroma and the properties of pure honey that is obtained from bees reared in the hives under modern methods, without killing the bees and destroying their combs.

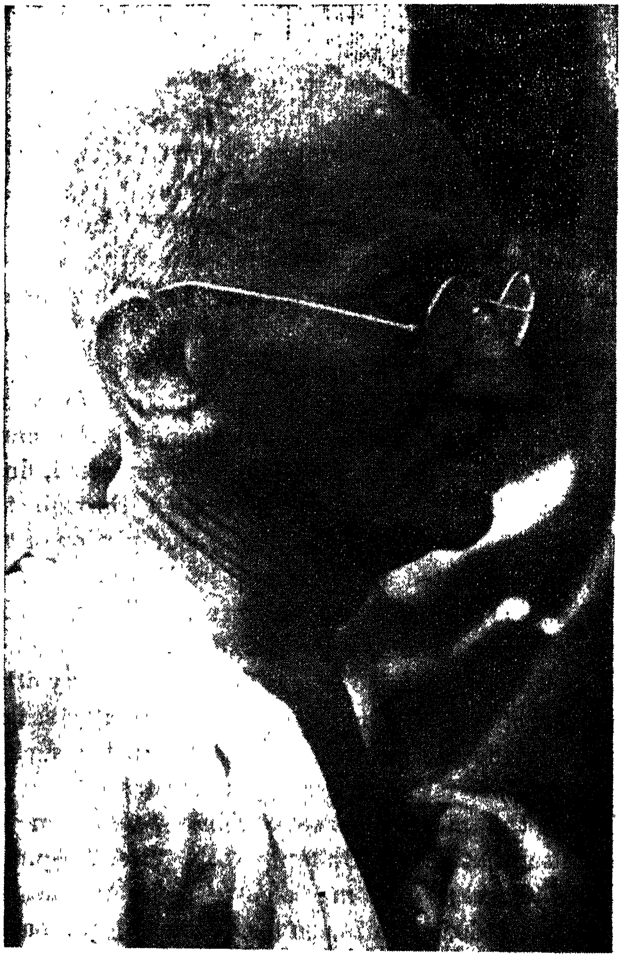
India abounds in luxurious forests. We have innumerable wild nectariferous plants, trees and shrubs. Ours is chiefly an agricultural country. Bees also get seasonal flow of honey from the cultivated fields and fruit gardens. (See 'Sources' page 199). In spite of all these natural advantages we lag behind, while others produce and export honey by tons. (See 'Bee-keeping in Other Countries', page 13).

We find that hive-bees exist plentifully in India and the wild colonies of Apis Indica, can be got in any number, and hived. We also know that we can divide bee-colonies artificially and increase their number and thus conveniently expand the size of the apiary (page 281). Instead of the crude method, as

now adopted, why not learn the up-to-date scientific method of bee-keeping and get a good supply of pure honey for our own consumption ? There is no merit in killing the bees and destroying their combs for the sake of wax, and squeeze out honey which becomes unfit for human consumption. On the contrary, the bees should be given comfortable shelters in properly-built hives so that the supply of pure honey may be ensured without the bees having to suffer for it in any way. (For the extraction of surplus honey, see 'Supering', page 190).

Market for Honey :— There is no export trade of honey, as has already been said, because nobody would care to buy the fermented, syrupy liquid in the name of honey. The substance, as it is now collected, finds its way to the dealers to be distributed through the grocers in the Indian Bazars. The accumulation of gas from the fermented honey, caused by the presence of the juice of eggs, grubs and bees, mixed up with pollen, creates trouble by breaking open the bottle, and the pressure inside is sure to force open any other container if that has not been very carefully sealed. Naturally there cannot be any attraction for such a rotten stuff, so far as export is concerned.

As to the internal market of honey we find in the Agricultural Research Bulletin No. 6 ("Bee Keeping", by C. C. Ghosh), that in Calcutta alone the dealers sell between 60,000 to 70,000 lbs. of honey, got out of wild colonies by squeezing the combs. We understand that in Bombay the total collection of honey by the crude method comes to about 84,000 lbs. annually,



GANDHIJI

AT KHADI PRATISTHAN, SODEPUR, (1939).

the main source of collection being places in the districts of N. Kanara, Satara, Belgaum, Kolada, Thana and Dharwar.

The export of wax from India in 1905-6 was 8,593 cwt., valued at Rs. 7,31,320 (Watt's "Commercial Products of India"). If we consider the yield of wax

A portion of the Bee Avenue : Sodepur Apiary.

Gandhiji used to take his morning and evening walks here while he was at Khadi Pratisthan, Sodepur, in April, 1939. (For the hives in the open, see page 117).

to be one pound for every 10 lbs. of honey, collected in the crude way, then the corresponding yield of honey against this 8,593 cwt. of wax, had been 96,24,160 lbs. in the said year. If we calculate the value of this

much of honey at a very moderate rate of three annas per lb. then it works up to 18 lakhs of rupees. The amount of wax exported annually from India and its value may be taken to have remained the same since then, if not increased. We can thus, well afford to pay our attention to export honey instead of wax, if we have any surplus after meeting our own needs, provided we take to modern methods. Even if we

Gandhiji on the Walk. Bee Avenue : Sodepur Apiary.

leave aside the question of exporting honey, the pure and wholesome food that this improved bee-keeping will bring us should be considered as a sufficient inducement to adopt it.

The 'Karorias' :— There should not be any apprehension from any quarter that artificial bee-keeping will take away the bread from the mouths

of those who collect honey by the old method. It is better that we discard the old practice, if we understand it to be bad. The process of extraction which makes one eat a mixture of grub-juice and honey can never be upheld. The 'karorias' (page 7) would do well to adopt the improved method and get a better price for their commodity. It would be easier for

Gandhiji : Along the Bee Avenue. Sodepur Apiary.

them to take it up as they are familiar with the bees, to some extent. Those who keep bees in box-hives and pot-hives should be induced to take to modern bee-keeping. Every help should be given to train them up.

Bee-keeping as a Hobby :— Bee-keeping is taken up by many as a favourite pursuit affording recreation.

It serves as a diversion from the monotony of routine work. It gives one the pleasure of extracting bottlefuls of sweet honey for the children, apart from the opportunity that the boys and girls get in studying the nature and habit of the bees that presented them with this delicious food. Bee-keeping, started for pleasure,

Gandhiji on the Walk : Sodepur Apiary.

with a couple of hives, may someday make one a professional apiculturist, absorbing his whole time.

Bee-keeping as a Cottage Industry : Possibilities of Commercial Apiary :—But it is not from the stand-point of a mere hobby that we look to this craft.

The possibilities of modern bee-keeping as a cottage industry in India are immense. It will give the village people an opportunity to supplement their income as a spare time occupation.

GANDHIJI ON THE WALK,
SODEPUR APIARY, APRIL, 1939.

From the left — Sj. Satish Chandra Das Gupta, Sm. Hemprabha Devi, Gandhiji, Dr. Sushila Nayar, Sj. Charubhusan Chowdhury.

It is for the educated classes to learn and adopt the modern method and make serious efforts for its spread, so that the agriculturists and the village artificers may take up the industry, and thereby make the regular establishment of apiculture possible in the country. It may take time to replace the old practice, but we must proceed with all earnestness to make it a success.

Bee-farms of 1,000 hives are not uncommon in America. There are apiaries in England having over 100 colonies in each.

In Northern India there are bee-keepers who own commercial apiaries of fair size that are well-kept and well-managed. At old and new Mahabaleshwar in the Satara district (Bombay Presidency), about 75 miles from Poona, there are several large and well-equipped apiaries, and one bee-keeper has over 300 colonies which are distributed over the place in different yards.

The number of bee-keepers in the country each owning ten to thirty colonies may not be few, and there are a large number who own colonies below ten each. The bee-keeping activities in Mysore and Coorg have already been mentioned. In the Travancore State, lots of persons depend exclusively on modern bee-keeping for their livelihood and earn their bread. (See pages 16-18, and Chapter-17, page 218).

Modern bee-keeping in India has yet to grow. Considering the vastness of our country it must be told that the number of bee-keepers here is only few. The apiaries that are established lie far apart. The

quantity of honey produced in these apiaries is also small. And it is not much that this small quantity of honey is disposed of without difficulty. More honey has got to be produced, and a taste for the consumption of pure honey created to the exclusion of the fermented syrupy liquid called honey, squeezed out of the combs as the old practice is, and whose quantity is very great. There should be a demand for pure honey and the consequent increase of its production both by starting new apiaries and expanding the size of the old ones, wherever possible. (See 'Marketing,' page 336).

The economic value of modern bee-keeping should be considered from the stand-point of a highly developed and skilled industry. There are other points of view from which it may be approached. These are the production of pure honey as a sweet, concentrated, wholesome food ; the service rendered to agriculture and fruit-gardening (pages 19-23) ; the utilisation of nectar that is wasted every year by converting it into pure honey to increase the wealth of the country.

CHAPTER XXIX

BEE-WHISKER

Newspapers and periodicals sometimes print illustrations of bees as also bee-men having odd whiskers made of clinging bees. A whisker like that looks very funny. It serves as a nice display of live-bees though clustering at a queer place. As a demonstration it serves to show how docile and obliging the bees are, and how they respond to kind treatment. In the cinema-film of bees produced by Mr. Choudhuri of Bari-Cuttack which has been referred to before (page 337), one will find a nice bee-whisker in the process of formation beginning with the clustering of a few bees till it is fully formed.

Bee-whiskers are made artificially by inducing the bees to cluster as a swarm, round about their encaged queen, the cage being tied below the chin of the bee-keeper. Tray-loads of bees may either be dumped on the head or face, or they may be allowed to crawl to the caged queen and thus form the cluster. But bee-wishkers may sometimes be seen to form without the least effort. Bees in such cases take the bee-keeper by surprise and utilise the projecting part of his face as a good natural support to hang down in a cluster.

We print here three photographs which were most kindly sent to us by Mr. H. Viswanathan. As an expert bee-man he worked in the apiary of Gandhi

Ashram, Tiruchengodu (Salem, Madras) and lately for some time he was in charge of the apiary attached to the Ganeshkhind Fruit Experimental Station, Kirkee (Bombay). The photographs were first printed in the weekly *Rashtra-vani Vol I.* (1939-40).

The illustrations speak for themselves. In August, 1938, Mr. Viswanathan was capturing a wild colony in Poona from the cavity of a wall. The bees

Fig. 79. Mr. Viswanathan and the Bee-Whisker.

swarmed out and took a fancy to settle on his chin (Fig 79). The swarm was afterwards hived by placing the brood chamber over his head (Fig 81). The following account from him regarding the incident will be very interesting to read :

"Bees all on a sudden rushed out from their original shelter and alighted on my face and then

spread themselves as conveniently as they could. Eyes, ears and nostrils were all covered with bees. I could neither open my eyes and see what was happening around, nor could I speak to my co-workers who were present, or hear anything from them. I was robbed of my senses and stood thus for over five minutes. I forgot myself and knew nothing. Slowly I came to my senses and there was a thrill and a feeling of joy at the unique experience on account of the peculiar behaviour of the bees in selecting my chin as their temporary resting place.

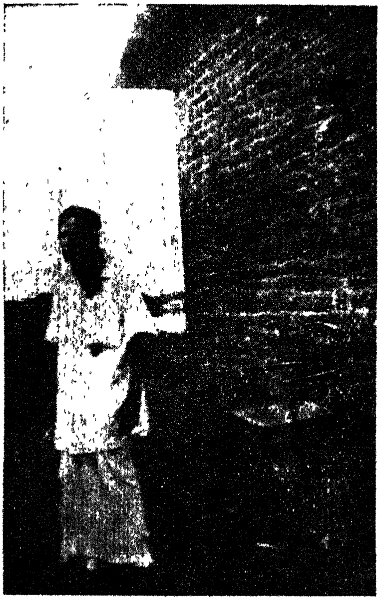


Fig. 80. The cavity in the wall shows the abode whence the bees took wing and clustered on the chin while the colony was in the process of being captured.

"Bees behaved perfectly well. They did not thrust any sting. Soon I felt the weight of the bees as they were moving on and gathering on the left side of my face. A mirror was procured and I enjoyed the queer whisker to my heart's content. A crowd also gathered in the

meantime and enjoyed the fun. Slowly I brushed off the bees from my right eye.

"I had an intense burning sensation in the left eye which was completely covered up by the bees. Tears began to roll down on account of the warmth caused by the cluster and the prick on the eyelids. Clinging of certain individual bees on the eyelids gave some gritty sensation both inside and outside the eye, while the warmth of the cluster fomented the irritated parts. This continued for half an hour till the swarm was hived by placing the brood chamber over my head and gently brushing the bees and guiding them into it.

Fig. 81. The Bee-Whisker, in the process of being hived.

"The left eye was found red as also the whole of the left face after the bees were cleared off. The burning sensation continued for about another half an hour, but there were no other after-effects. Since then I had three more of these bee-whiskers while capturing wild colonies."

CHAPTER XXX

OTHER HONEY-BEES

There are different species of honey-bees having common characters. The bees that are generally found in India are classified as *Apis dorsata, Apis indica* and *Apis florea* (page 35). As has been fully described, the Indian Bee (*Apis indica*) is the commercial variety in India which can be hived successfully under modern methods for honey collection. *Apis mellifica* is the European bee. (For 'Rock Bee', see Chapter - 31).

European Hive-bee :— As stated above, the honey-bee of Europe is called *Apis mellifica.* The European bees, like the 'Indian Bees', build parallel combs and are domesticated in Europe, America and other countries. They are bigger in size and are better honey-yielders. (See 'Yield in Other Countries', page 225).

There are several varieties of this class of bees which belong to different countries. They differ in their colour and stripes. They have their own peculiarities; some are not so docile, some are less prolific, and some are more inclined to swarm. They may generally be divided into two classes, namely, the black bee, and the yellow bee.

The yellow class of bees was originally found in northern Italy and then imported by the bee-keepers of most of the countries. The queen of the Italian or Ligurian bee (it takes its name from Liguria) is as

large as a rock-bee worker. Of the other bees the names of Carniolan (from Carniola, formerly a province of Austria and situated on its south), and Caucasian (from Caucasus) may be mentioned. But the Italian bee is most praised on account of its high qualities. (See 'Bee Diseases in European Countries', page 67, and the 'European Bee and Diseases', page 226).

Size of Cells :— The Plains-type of Indian Bee has 6 worker cells to the linear inch ; and 6 drone cells measure $1\frac{1}{16}$ inches.

In the North Bengal area, six worker cells of the Hill-type of Indian Bee measure $1\frac{1}{16}$ inches or about $5\frac{1}{2}$ cells per linear inch. The size of its drone cells varies greatly. Generally, the bees have 5 drone cells to the linear inch, but we have seen $4\frac{3}{4}$ and $4\frac{1}{2}$ cells to the inch as well. The size of the drone cells sometimes differs even on the two sides of the same comb.

It should be borne in mind that the sizes of cells of both the Hill-type and the Plains-type of bees vary to a certain extent from place to place, particulary of the Hill-type according to the altitude. (See pages 105 and 188).

At Nagrota (Punjab, altitude 3,000 ft.) the bees have $5\frac{1}{2}$ worker cells per linear inch, i. e. 22 cells per four linear inches, whereas at Raison (Punjab, altitude 4,500 ft.) they make $21\frac{1}{4}$ cells per four linear inches. As has been stated before (page 106), the Entomological Department of the Punjab Government makes worker-base comb foundation which has 21 cells per four linear inches, i. e. $5\frac{1}{4}$ cells per linear inch. (Also see pages 223 and 224).

The European bees have about 5 worker cells to the linear inch, and the drone cells measure about 4 to the linear inch.

Five worker cells of Rock Bees measure $1\frac{1}{16}$ inches or about $4\frac{3}{4}$ cells per inch. Cells $4\frac{1}{2}$ to the inch are also found. Their honey-cells are specially prepared at the side of the comb, and they measure 4 to the linear inch. The Little Bees have 9 worker cells to the inch.

In the combs, some of the cells may be found which are irregular in shape. These are called *intermediate* or *accommodation* cells, and are built to connect the worker and the drone cells or the queen cells, as the case may be.

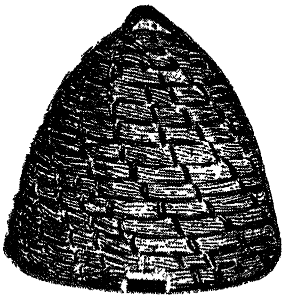


Fig. 82.
The Straw Skep.

Old methods in England and America :— The primitive method of keeping bees is the same everywhere, be it in India, Europe or America. And there is a similarity in the cruel process of smothering the bees and squeezing out the combs. Bees are kept in *skeps* placed on wooden floor-boards or in boxes, instead of earthen pots (page 7) as in India. Packing boxes are in use in India too.

The Skep—The skeps are made of straw (Fig. 82). These are like grain-baskets. Imagine an ordinary *Dhama* of split cane, or a closely interwoven *Tokri* of half-split cane, turned upside down, placed on a piece of wooden board, and you get a skep. There is

a small hole at the rim for the entrance and exit of the bees. In some of the English Primers intended for Indian children, illustrations of skeps are printed and a few words said about the 'busy bee'.

Swarms are hived in skeps, and the bees build combs inside. Stray swarms sometimes take shelter in the empty skeps, kept so for the purpose. Combs hang down from the top and the sides of the skep where they are firmly attached, as one would find here in the pot-hives, the log-hives and in the cavities of walls. Keeping bees in straw-hives means the destruction of a number of bee-colonies every year for the combs to be removed in order to squeeze out the honey.

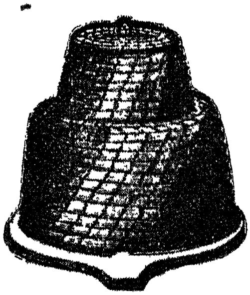


Fig. 83. Flat-top Skep with Super.

Bees are left in the skeps severely alone till the 'fragrant clover' becomes brown, when the heaviest of the colonies are selected to yield the most honey, and in the evening they are removed, placed over a burning sulphur pit, thus smothering the bees. Combs are then removed and the honey squeezed out between the hands or pressed with a honey-squeezer made of a pair of wooden boards hinged at one end.

Some advance was next made by the skeppists when they provided a super by opening a hole on the flat top of the breeding skep and placed a smaller skep on it (fig. 83). In this upper chamber the bees stored

honey exclusively, as the queen rarely goes there through the narrow passage to lay eggs.

The introduction of the movable frame solved the difficulty. And in order to change from the old to the modern method, the bees are first driven out of the skep into a box or an empty skep ; the combs are then cut out, tied on to frames and placed in a brood chamber. The bees are then hived in the usual way by dumping them on a hiving board, so that they may get through the entrance. There are methods of 'driving' the bees from the skep, into the details of which we need not go.

The Box-hive—In America the old practice is to keep the bees in boxes which measure about 15" square, the height ranging between $1\frac{1}{2}$ ft. and 2 ft. They are without frames, and have no movable parts. In the centre of the box there are two sticks across. They give additional support to bear the weight of the combs that hang down from the sides and from the top. At the close of the season, the weights of the boxes are tried, the heavy ones are picked up, the bees are destroyed with sulphur fumes and the combs cut out.

But the days of the box-hives, the skeps and the skeppists are gone, though some may still be following the old practice. The movable-comb hives have replaced the old equipment for harvesting honey and rendered the destruction of the bees unnecessary. The dome-top skeps are in use for carrying and hiving the swarms, and they serve this purpose well.

CHAPTER XXXI

ROCK BEE

The rock-bee *(Apis dorsata)* is the biggest of all honey-bees. In some places it is called *Bagha Machhi*, *Bagha Mohu* and *Pahari Mohu*. It builds comb in the open. The comb is of large dimension measuring generally over 3 ft. in width and over $1\frac{1}{2}$ ft. in depth. And it should be noted that a single comb makes up their colony. The honey is stored in the upper part of the comb, particularly at the sides, in big cells (page 356). The rock-bees are very good honey-gatherers. A single comb is said to yield up to 60 lbs of honey. They are migratory, and they cannot be domesticated. (See page 36).

Rock-bees or Giant Bees, as they are also called, are really giants among honey-bees. They are exceedingly vicious. Their stings are very painful. When enraged they come out in battle array and attack indiscriminately any person or animal that may happen to be near about. Being mad with rage they even thrust their stings on inanimate objects. A single sting will be enough to make one feel how severe it is.

The bees are generally provoked by urchins. They throw stones at the hive for fun. But the prank results in serious consequences. The anger and confusion of the bees are sometimes caused by fear

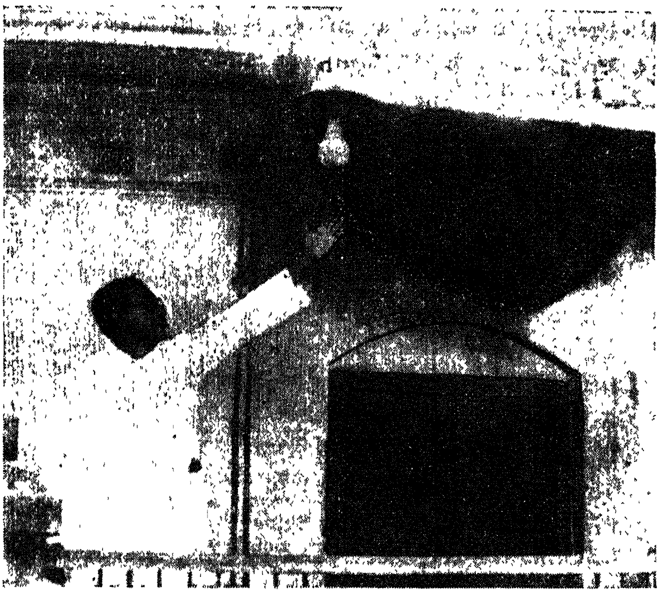
at the sight of a man or an animal approaching the place or passing by it even far away from the hive. Yet cases are known of rock-bees having built combs under the eaves of houses, behaved quite gently and did not disturb the inmates in the least.

We had an occasion to see a colony of rock-bees in October, 1939, at the residence of Mr. Hari Charan Mukherjee, Calcutta (12A Ramratan Bose Lane, near Deshabandhu Park, Shyambazar). The colony was there for some time past. It was a thickly populated, nice colony which measured about 3 ft. in width and 18 inches in depth, hanging in the shape of a semi-circle from the projection of a flat roof in the third storey.

The swarm settled at the place in March and the colony grew in size and got that shape in seven months. The comb was straight and covered with bees three to four deep. The inmates of the house were used to spread out their clothes in the sun on the railing near the comb, but the bees did not feel least disturbed for it.

The author approached the comb and stood near it. He extended his left hand towards the comb, and as the fingers were just touching it, the bees close to the fingers moved away and a portion of the white comb with its big cells came into view. The foragers were very busy. They were coming to the comb and going out in a continuous stream. The upper layer of the adhering bees had been shaking off their wings in quick movements at short intervals in small batches here and there. We were informed that they had

been in the habit of doing this throughout the day. A sound like *chit chit* could be distinctly heard when they thus shook off the wings. The foragers were unmindful of our presence, and the adhering bees too took no notice of us.



The author and the colony of rock-bees in North Calcutta.

We were informed that while an inmate of the house was once removing a wet napkin from the railing referred to, he accidentally pressed a bee that was in its folds and was immediately stung. A second incident happened in a similar way while removing a cloth. These two were the only unhappy incidents

that occurred during the stay of the colony for so many months. The spot where the colony was found bore the old marks of two more combs that had been built in the two previous seasons.

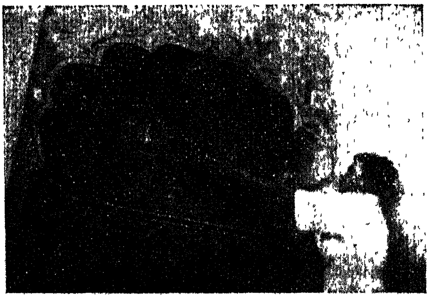
Handling Rock-bees :—The rock-bees are proverbially ferocious. But it is difficult to say whether there exists a milder type of this bee, or whether it is the environment and the attitude of non-interference that make them behave gently, as

(1) Mr. Viswanathan interesting himself with the rock-bees. The colony is hanging from an arch of a Shiva Temple at Hubli (Dharwar, Bombay).

the bees did at Mr. Mukherjee's place. The mild disposition and friendly response of some of these bees will be further understood from a different set of photos printed here.

In two of these photos Mr. Viswanathan (page 350) will be seen interesting himself with a colony of rock-bees located under the beautiful arch of a doorway of a Shiva temple at Hubli, district Dharwar, Bombay. The bees, as could be seen, were exceptionally calm.

In the third photo, a boy will be seen to have touched another colony of rock-bees hanging from a different arch of the same temple. He was picked up by Mr. Viswanathan from amongst a number of visitors to the temple who saw him handling the bees. When approached, the boy readily agreed to come and help. There was something in his eyes which attracted Mr. Viswanathan to pick him up from amongst so many visitors.



(2) Mr. Viswanathan, now handling the rock-bees.

With full confidence in the bees Mr. Viswanathan took the boy up and made him stand on a ladder to reach the comb. He stood there with his left hand on the bees. The photo shows how the bees responded to this gentle but courageous and deliberate handling. Thanks were due both to the boy and to the bees for their mutual understanding, for, he came out successful without a sting. At the time there were more than 150 colonies of the same type of bees

settled in the different corners and in the various arches of the temple. That was in November, 1938.

Mr. Viswanathan informed us at the time that he had many more friendly contacts with rock-bee colonies in different localities. But with the same type of bees he had a painful experience too on one occasion when one of his co-workers got more than

(3) The boy and another colony of rock-bees hanging from a different arch of the same temple.

250 stings. He had alarming symptoms, but he came round. This must be a clear warning, if that is at all necessary, that the handling of rock-bees is not an easy work and it is not for all to hazard it, as the bees are undoubtedly ferocious and they rarely brook disturbance.

In the fourth photo will be seen a "honey-tree" in a village named Sahasrahally in N. Kanara. The honey-bees might have something to do with the

name of the village, for, *Sahasrah* means thousand, and *ally* (*oli*) is honey-bee. The dots and the bigger dark spots on the tree indicate so many colonies of rock-bees, the total number of which, as can be counted, was seventy. That was during the second week of February, 1939. The deciduous tree seen here is *Adina cordifolia.*

(4) The "Honey-tree" at Sahasrahally in N. Kanara. The dots are so many rock-bee colonies.

Bees in Calcutta :—There are all the three kinds of honey-bees in Calcutta. The colony of rock-bees found in North Calcutta (page 360) was not the only colony of its kind, for, we have seen more of such colonies in the said locality and in different parts of the city.

We have seen a few colonies of Little Bees (*Apis florea*) hanging from the branches of small perennial flower-plants in gardens in front of dwelling houses.

Once we had occasion to remove a colony of Little-bees from the house of Mr. Prabhat Chandra Ganguly in the Kalitala area (6 Guruprasad Choudhuri Lane, Calcutta). The colony was in a bath room in the first floor. The comb was cut out with the adhering bees, transferred to a box and removed to Sodepur. But the bees decamped on the next day.

We have also seen wild colonies of *Apis indica* in the city. At the place of another friend in South Calcutta, a swarm took shelter in an abandoned box that was lying at a corner in the top floor. We have seen a swarm in the suburb that took shelter in a letter-box kept on the verandah of a building.

So, wild colonies of all the three kinds of indigenous bees are in the city. A visit to the flower-stalls at Chitpur, College Street Market, Bowbazar Market or for that matter, any other open flower-stall and also to the flower-beds in the Municipal Parks of Calcutta will show how the bees are busy in sucking nectar from the flowers, darting out in the air and vanishing quickly. The presence of wild bees and the bee-colonies in the city of Calcutta confirms the possibilities of keeping bees in large cities and towns under modern methods in the artificial hives. (See 'Yield per Hive', pages 219-'20).

CHAPTER XXXII

SUPPLY OF HONEY IN THE PAST

In Watt's 'Commercial Products of India' we get a fair account of the regions of production and supply of honey and wax of this country in the past. Incidentally, it gives an idea as to the extent of business done in those two commodities. And further, it acquaints us with the old methods, then adopted, in the various provinces of India in securing and domesticating wild colonies of *Apis indica* as also controlling their swarming tendency.

It has been stated that wax was sometimes neglected and the production and sale of honey became the important aspect. The greater portion of honey was obtained from the colonies of rock-bees; the regions of supply had been the United Provinces, the Central Provinces, Berar, Bombay and Madras.

The next in importance was the honey obtained from the colonies of *Apis indica*, kept in a state of semi-domestication in the Khasia hills and the mountains of the United Provinces, of the Punjab and of the N. W. Frontier Province. It was the chief source of the honeys of Assam, the Punjab and also of Bengal. The following abstract will be interesting:

(1) **Punjab**:—The domestication of bees for honey, and the collection of honey and wax from the wild colonies were confined to the hilly country. Of the

districts, the most known were Bashahr, Chamba, Hazara (page 224, last para), Jhelum, Kangra, Kashmir, Kullu, Simla etc. The supply of wax from Bashahr which was used to be sold in the annual fair of Rampur came to about 20,000 lbs.

Bee-keeping was practised in Hazara for the sake of honey, and the wax that was obtained appeared to be largely used up locally. In Hazara the honey used to be collected in November, in Kullu during July, and again in October, while in Chamba the seasons were May to June, and September to October. (For further details about Hazara, see 'N. W. F. Province', below). In Kangra, 2 to 3 maunds of the annual production of wax were employed by the brass and copper-smiths in moulding their wares. In Kashmir it was gathered from September to October. The colonies yielded from 20 to 40 lbs. of honey and 2 to 4 lbs. of wax. (For further details about 'Kashmir', see below).

Regarding the domestication of bees in the Himalayas, we find that in Bashahr one, two or three storeyed houses were often specially kept for rearing bees. In the walls of these houses, small recesses were made two feet apart and closed on the outside by a wooden panel having a hole for the entrance and exit of the bees. A man was usually kept in charge of such a bee-house, and it was his duty to prevent 'overswarming'. This was effected, as has been already stated (page 321), by giving ample room to each colony, and sometimes by clipping the wings of the queen. The man in charge had to keep the apiary

well-stocked with early swarms, and to protect it from the attacks of bears, martens, hornets, caterpillars and the like. Wild swarms were captured and brought to the apairy. But where bee-keeping on a large scale was not contemplated, it was customary for the hill people to provide one or two recesses in the walls of their dwelling houses for a few swarms to be accommodated there. In Chamba, Hazara, Jhelum, Kangra and Kullu the same method was followed as in Bashahr. Swarms were looked for in the jungles and carried off to the house of the zamindar.

(2) **Kashmir** :—Regarding the bees in Kashmir we find it stated that a honey-bee *(manchtilr)* was almost completely domesticated. It has been further suggested that this bee was "a variety of *A. indica* hardly separable from *A. mellifera*".

(3) **United Provinces** :—The supply was drawn from the Eastern Dun Forests, Khari etc., the right of the collection of honey and wax having been leased out. The trade was chiefly in the hands of the traders of Saharanpur.

(4) **Central Provinces** :—We find that bees had been plentiful in the forests of these provinces. Wardha, amongst other places, was a source of supply of honey and wax. Ratgarh hill had been described as a "hive of bees". In Chadgarh it was impossible to beat the forests for big games on account of bees. Of the chief localities of supply of honey and wax, we find the following names,—Betul, Chanda, Chhindwara, Damoh, Hoshangabad, Jabbalpur, Mandla, Nimar, Raipur, Sambalpur and Wardha.

There were two seasons for the collection of honey and wax, namely, April to May, and November to December. The annual yield from the forest areas was estimated to be 500 maunds of honey and 100 maunds of wax. According to season and quality, the price of wax ranged from three to twelve annas per pound locally.

(5) **Berar** :— The districts most noted in Berar were Ellichpur, Mangrul, Melghat and Wun.

(6) **Bombay** :— The honey and wax of this Presidency were stated to be drawn mainly from Khandesh (Satpura mountains largely) and the Deccan. The chief localities were—Belgaum, Dharwar, Kanara, Panch Mahals, Ratnagiri, Satpuras, Satara and Salsette. The exports from the Presidency went mainly to the towns of Bombay and Goa.

(7) **Rajputana** :— A small supply of honey and wax was stated to be obtained from Ammer, Baojari, Dewari, Mandla, and Todgarh.

(8) **Madras** :— Regarding Madras we find that bees were met with in all the mountains and low hills of the Presidency, the chief centres of supply being Bellary, Coimbatore, Cuddapah, Ganjam, Godavari, Kistna, Kurnool, Madura, Malabar, Nellore, Nilgiri, North Arcot, South Kanara, Trichinopoly and Vizagapatam.

(9) **Khasia Hills** :—In the Khasia hills we find that the domestication of bees in the crude method was in existence. The swarms of *Apis indica*, captured in the jungles, were used to be kept in small boxes under the eaves of the houses. Apart from the

use of honey as an article of food and its use to preserve fruits we find it stated that "in the Khasia hills, apparently, human bodies are sometimes temporarily preserved in it."

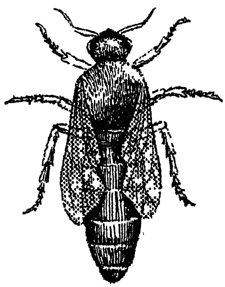
(10) **Other Provinces** :—Of the other provinces the names of Assam and Bengal have been mentioned at the beginning of this Chapter. It may be further mentioned that the supplies for Bengal were drawn by Calcutta from the Sundarbans, Chota Nagpur, Chittagong, Darjeeling, Bhutan and Nepal. As for Assam it has been stated that the dealers had their residence in Sylhet and they obtained their supplies from the Khasia hills (see above) and tracts beyond the frontier. (For *Kamala Madhu* of Assam, see page 202). As for the N. W. F. Province, see the note below.

(11) **N. W. F. Province** :— Regarding bee-keeping in the Hazara district, the following is quoted from the District Gazetteer (1907)— "The keeping of bees in the hill-tracts is very common. To start a hive a chamber about 4 cubic feet in size is made in the wall of a hut, generally on the south or south-east side, so as to face the sun, with a small entrance-hole, the edges of which are smeared with a mixture of honey and the pounded wood of the Chaura plant, to attract a swarm. The honey is extracted in the months of September, October or November, after smoking out the bees. The average yield of a hive is 15 seers, one-fifth of which is left for the bee's winter food". (For Hazara, also see 'Punjab' at the beginning of this Chapter).

CHAPTER XXXIII

THE MATING OF QUEEN

It is generally known that the queen-bee mates with a drone in the air while on the wing on what is called her nuptial or wedding flight, only once in her life-time, and being impregnated comes back to the hive and goes on laying fertilised eggs till the seminal fluid received from the drone is exhausted. And if after that, she still goes on laying, then those eggs being not fertilised will produce drones only. (See page 49). But before she comes to such a pass, the bee-keeper, having found out the queen's inability to lay enough fertilised eggs to keep up the population, will understand that she is failing. Under such circumstances the usual practice to keep the colony strong is to remove the old or the failing queen and rear a new one or introduce a young healthy fertilised queen. When the bee-keeper fails to do that in time, the bees often take the initiative to themselves and build a few queen cells, called 'supersedure cells', in order to supplant her, and get a new queen so that the colony might not come to grief. (See 'Supersession of Queen', page 259).



Queen.

The bee-keeper removes the old and the failing queen in the belief that once the queen is impregnated

and has started to lay, she will not mate with the drone a second time, as is generally the case. But there are exceptions. Though uncommon, one may on a rare occasion find a laying queen to mate for the second time when she shows sings of failing. Such an instance is given below. It so happened that a queen in our apiary had mated for the second time after having once mated and started to lay.

The queen in question was of the Hill type and she had a peculiar history. While a virgin, she took 32 days to mate (page 49) though it was springtime and the flow was on, and there were drones. Thus from the very start she proved to be an exception.

After mating for the first time, the queen started to lay eggs in May (1939). But she could not cover more than three British Standard frames with brood at any time. Her failure to enlarge the brood-nest may be due to some defect in her on account of the abnormally long time she took to mate. It might also be due to insufficient or improper nourishment because the nurse bees had been growing old as time wore on and she had failed to mate.

By the middle of February next year (1940), the population fell down alarmingly, though it should have increased on account of the approach of the swarming time. There were only a few eggs and sealed grubs. The queen showed signs of failing, but there were no queen cells. She looked lean and the abdomen contracted in size.

On the 4th March (1940), the colony was examined at noon. The queen looked as before, and the hive

was closed. Half an hour after, the queen was found flying in front of the hive, up in the air. A few minutes later she came back and sat on the shed under which the hive stood. She was caught in a match-box and released on the top bars of the brood-frames. It should be noted that all the other hives near the one in question had queens of the Plains type.

On the 16th March the hive was again opened. While one of its combs was under examination, the queen took wing from the brood chamber. She was again caught and released inside the hive. There were no eggs or fresh grubs. She looked as lean as on the last occasion. Her repeated flights led to the suspicion that she might be in the habit of coming out thus, without our knowledge, to meet the drone.

Ten days after, the hive was again examined and the queen was found this time to have amazingly developed in size, regaining her original majestic form. The abdomen was distended fully, and she looked like a full-fledged lady, heavy with burden. On further examination, eggs were also found in the cells which when sealed proved to contain worker grubs, and in due course the workers emerged. It was an unmistakable instance of a queen that did mate for the second time, once while she was a virgin and again in the second year after laying.

In a few more instances we have further found that the virgin queen, having once been impregnated, went out for the second and the third time on mating flights before laying. But such queens, as we have seen, did not give satisfactory results.

CHAPTER XXXIV

LAYING WORKER AND QUEEN CELL

Reproduction without fertilisation is called *Parthenogenesis (parthenos,* a virgin, and *genesis,* production). It is reproduction through the development of an unimpregnated egg. We know that if the queen-bee fails to mate, she remains a virgin ; such queens lay eggs which produce drones only.

We know too that the fertilised queen can lay both impregnated and unimpregnated eggs at her will. The former produces the female (either worker or queen), and the latter the male, i.e. the drone. The same fertilised egg that produces the worker can also produce the queen, according to the nature of the cell which the egg occupies and according to the kind of food which is supplied to the larva by the nurses. (See 'The Queen', page 47).

The queen is a fully developed female. The worker, though a female, is imperfectly developed and is of stunted growth. Her sexual organs exist only in a rudimentary form. Normally, therefore, the worker cannot lay eggs. But on account of some reasons, which may be due to chance overfeeding of royal-jelly in the larval period, the rudimentary organs of some of the workers develop to a certain extent, and the result is that such workers under certain peculiar

conditions of the colony lay eggs. In appearance, size and general behaviour the 'laying workers' are like the other workers of the colony. Therefore, they cannot be distinguished from the rest, if they are not found actually laying, or singled out by the conduct of other bees towards them.

The laying workers cannot mate and so they cannot lay fertilised eggs. Their eggs, when hatched, can produce drones only. And on account of the eggs being laid in the worker cells which are smaller, the drones that are produced are also smaller in size. (See 'The Worker', page 52).

The laying workers or 'fertile workers' as they are also called, are not tolerated in a colony which has a laying queen. But in a queenless colony, when there are no impregnated eggs or young worker-larvæ to raise a queen, or if the rearing of the queen has been delayed somehow, one or more of such workers pose themselves as mothers. They take upon themselves the task of laying eggs, so intense is their love for the colony to save it from utter ruin in the absence of a queen.

Sometimes they lay one, but generally several eggs in a single cell. The eggs are deposited in the cells indiscriminately, here and there without any order. All the empty cells of the combs are thus charged with heaps of drone eggs, and they look repulsive. They lay eggs even in the queen-cells drawn out by the workers in their attempt to re-queen the colony. The workers clean up the cells by removing the extra eggs, leaving only one in each. (See 'Removal of

Eggs by Workers', page 275). They go so far as to start queen-cells even round the drone-larvæ.

The nurse bees lavishly feed the drone-larva in the queen-cell. The pupa dies. Sometimes the drone develops fully, yet dies in the cell. The walls of such 'queen'-cells are plain and smooth. They are generally

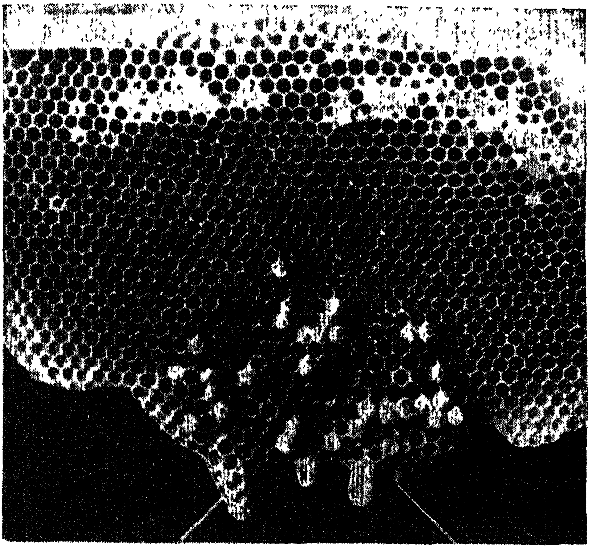


Fig. 84.
Dwarf 'Queen'-Cells Containing Drone Pupæ.

drawn abnormally long, and they look ugly. (Fig. 19, page 53). Sometimes they remain dwarf; three of such 'queen'-cells containing drone pupæ are printed here (Fig. 84). Sometimes dimples and corrugations are found on the walls of the dwarf cells as will be evident from the left hand cell in Fig. 84.

The laying workers often demolish queen-cells when they are grafted for queen rearing. The colony becomes thoroughly demoralised when fertile workers get possession of it for some length of time, and under such circumstances the bees will rarely build queen-cells if a grub comb be given to them.

When a colony is de-queened, or when it loses its queen, the workers in their usual course prepare queen-cells, and before the cells are ripe or the queen has emerged, fertile workers in some cases may begin to lay. But the presence of the virgin queen generally stops such egg-laying. Sometimes the fertile workers continue to lay eggs till the virgin has been impregnated, and sometimes till she started laying.

And, if by chance the virgin queen fails to return after a mating flight, a mature queen-cell may be grafted or a young laying queen may be introduced. If neither can be arranged for and laying workers make their appearance, the best course would be to unite the colony with one having a queen, instead of losing time in an attempt to rear a queen by providing a grub comb, for, the laying workers would make that practically impossible. (For 'Uniting Stocks', see page 247).

In the alternative, a strong queen-right colony may be divided and the nucleus placed on the stand of the queenless colony having fertile workers, and the latter should be removed some distance away and kept on a different stand. Most of its bees being old foragers will now join the nucleus, leaving only a few foragers and the laying workers. And, in order to isolate the

latter, the colony having the laying workers should be broken up a day or two after, and the bees shaken off on the ground a few hundred yards away from the original stand. The laying workers being not on their wings for sometime will fail to return to the nucleus, while others will go back. And, if a few of the laying workers anyhow find their way, they will not be able to do much harm, for, the nucleus will have enough of its own bees to raise a queen.

The combs of the broken-up colony, containing drone grubs and eggs, may be used again after they are cleaned up by picking out the grubs from the cells, one by one, with a pair of forceps, and crushing the eggs with the round head of a match-stick.

CHAPTER XXXV

VAGARIES OF A STRAY SWARM

In the photo printed here will be seen a cluster of bees on the front wall of the hive, near the entrance (Fig. 85). The whole of the alighting board will be found to be so covered. And some of the bees have clustered underneath the alighting board too. The sign is apparently that of queenlessness. It looks as if the colony has thrown out a swarm a little before. It happened thus :

Early in the month of May a stray swarm was found hanging from the branch of a tree about half a mile away from our apiary. On enquiry at the place it was learnt that the swarm had been there for the past three days. It was abnormal for the bees to keep themselves clustered in the open for such a long time. A natural swarm would not have behaved like that. It seemed that the bees had been driven out of their wild abode by somebody to secure honey. It was not known how intensely they had been smoked and how many of them had been suffocated or burnt to death.

The cluster was fairly big. The bees were captured in two swarm-catching nets and brought to the apiary in the afternoon. A hive was made ready to receive the swarm and set up in position with two brood combs containing eggs, and grubs in different stages,

and two other frames of drawn combs, four in all. The swarm was hived forthwith in the usual way. Sugar-syrup was given to the bees in bottle-feeders.

Peeping through the top-ventilators in the same evening, it was found that the bees had left the combs and clustered on the roof at two different places.

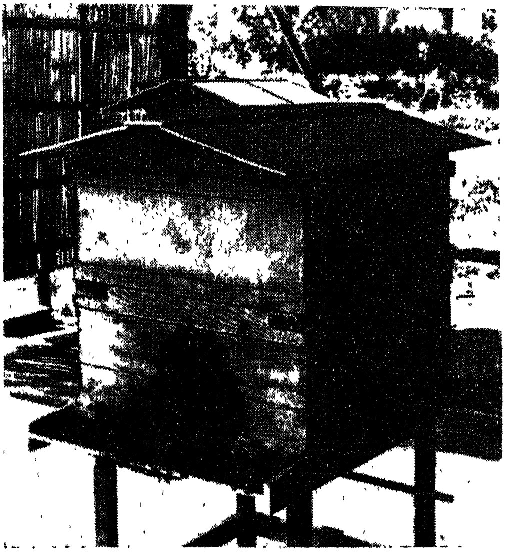


Fig. 85. The sign of distress.

The roof was raised, and the clusters were thrown down over the top-bars of the frames with the aid of a feather. The hive was then closed. An hour after, when it was dark, a mild hum was heard inside the hive which indicated that the bees had settled themselves on the combs. (See 'Listen to the Hum of the Bees Inside', page 150).

Next morning the foragers were seen working regularly and bringing in pollen. The roof was raised and the bees were found to be working quietly. Except some restlessness of a few bees at the entrance, nothing abnormal was noticed.

The hive was next examined on the fourth day. The queen was missing. Lots of eggs were seen in single cells indicating the presence of laying workers. Queen cells were also found, but they all had several eggs of laying workers. No royal-jelly could be found in any. Apparently, the swarm had clustered on the tree without the queen, and the laying workers started their work soon after the bees had settled themselves on the combs.

In the evening these bees, as hived on the four frames, were united with a queen-right colony by applying smoke (page 248). Half an hour after, lots of bees rushed out of the hive; they crawled up and covered the whole front of the hive upto the gable. The whole of the alighting board was also covered thus. They remained so during the night.

Next morning the bees were found on the front wall of the hive and on the alighting board in the same condition as they had been during the last evening after they were united. The hive was then examined. The queen, attended by some workers, was seen moving on a comb quite unconcerned. The four combs of the queenless bees were practically empty, while the remaining combs had bees adhering to them. So, it was the stray swarm of bees that had rushed out of the hive after they were united.

The hive was closed ; the bees adhering to the front-wall of the hive were slowly brushed down on the alighting board and gently pushed in. In the afternoon, they again came out and behaved as before ; they were again driven in. This continued for two weeks, but their sign of distress diminished gradually as each day passed till it finally disappeared, and the bees settled down to their normal work. The photo before us (Fig. 85) was taken after a week when they had quieted down a great deal.

It may be concluded that it was the smoke used in uniting them, however small its quantity might have been, that made them terribly nervous and behave so madly. The few puffs were sufficient to throw them into confusion and extreme fear. It made them recollect that dreadful day or that night when they had been smothered but escaped somehow. Being thus alarmed they refused to stay inside the hive, and showed signs of distress which took so many days to subside. How mercilessly they must have been smoked when they were driven out of their natural abode, and how severe the shock had been to them !

CHAPTER XXXVI

THE HONEY-BEE AND THE RAINY SEASON

Scarcity of Food :— The worst season for the honey-bees, in the Plains, is the rainy season. Blossoms there are hardly any during this time, the supply of nectar and pollen is scanty, and the little all that may yet be available also wash out on account of the rains. Food, therefore, becomes scarce.

Decamping and Robbing :— Bees cannot go out as freely as before, and they are to keep themselves confined in the hive whenever rains continue for days together. One should see that the bees do not suffer for want of food. They must not be starved (page 159). The scarcity of food compels them to abscond. And it is during the rains that robbing occurs most ; the weak colonies succumb to the inroads of the robbers.

In order to baffle the robber-bees when robbing is on, the use of *carbolic cloth* is also in practice. The carbolic cloth is nothing but a small piece of cloth of suitable size, soaked in weak Carbolic Lotion (say 1% solution of Carbolic Acid), and the excess of water squeezed out. The cloth is then spread over the alighting board up to the entrance. For a time the robbers keep away on account of the pungent odour, but when they become accustomed to it, and when the attack is severe, the carbolic cloth cannot save the situation. (See 'Robbing and Fighting', page 232).

The Wax Moth :— Then there is the wax moth. Out of so many natural enemies of the bees, the wax moth is the worst. (See 'Wax Moth', page 59). And during the rainy season one can never be overcareful so far as the wax moths are concerned.

Moths generally come during the night. But we have also seen that they come even during the day, and lay eggs. They need not necessarily lay eggs on the comb. Particles of wax-cappings or other refuse matters on the bottom board give them a good breeding place. Nay, any crevice or a slit in the hive will be quite good if they can conveniently push in the ovipositor. Patches of eggs may be found at any place between the top-cover and the super, the super and the brood chamber, and the brood chamber and the bottom board. This is very common. And, though it may seem strange, it is a fact that wax moths even lay eggs on the hand, in the crease between the fingers or in the hollow of the palm, when kept confined there.

Fig. 86.
Wax Moth Laying Eggs.
Eggs may be seen in the crease between the forefinger and the thumb. After laying a few eggs, she was hurriedly turning the ovipositor this side and that in search of a suitable spot for laying. The ovipositor is now on the nail.

In the photo printed here (Fig. 86) will be seen a moth laying eggs in the crease between the tips of the

thumb and the index finger. The ovipositor may also be seen. The moth was observed on the back wall of a hive during a morning stroll in our apiary. It was captured and when held between the fingers it started to lay. Moths so captured at noon, or in the afternoon, also laid eggs in the same manner. We experienced this peculiar behaviour on several occasions.

The eggs of wax moths are of dull white colour, and they are so small in size that to the naked eye a cluster of eggs looks like a small patch. When pressed with a knife-blade they break with a sharp cracking sound.

During the rains, weeds grow over-abundantly. And wax moths may be found hiding under the blades of grass or in the weeds that may be near about the hive in the yard, and they are sure to reveal their presence if these be stirred up with something. The bee yard should, therefore, be kept free from weeds.

The havoc created by wax moth caterpillars is known, more or less, to all bee-keepers. They eat away the combs and make tunnels inside (Fig. 22, page 63). The empty cells of the infested combs in a hive, when left alone by the bees, are covered with silky webs (Fig. 86a, page 387). The black pellets of excreta on the alighting board or on the bottom board indicate the presence of the caterpillars.

During the rains, the colonies should be examined at least once a fortnight and the hives changed. (See 'Regular Inspection', page 178). One should see that the combs are fully covered by the bees. All empty combs should be removed from the hive. Any comb

or any portion of it, abandoned by the bees, should be looked upon with suspicion and carefully examined, for, the possibility is that it is infested.

The infested combs should be cured by sunning (page 63). The empty combs that might have been removed from the hive and stored at the end of the flow season should now be examined. They also require repeated examination in order to keep them

Fig. 86a. An Infested Comb.

free from the possible attacks of catterpillars when so kept in the store. The combs that have been rendered useless due to the ravages of caterpillars should be broken into small pieces and pressed into balls for the extraction of wax. (See 'Extraction of Wax' in Chapter - 43).

Hives must be kept well protected from rains (page 117), and firmly tied to the stands from being thrown down by storms (page 123).

CHAPTER XXXVII

EXTRACTING HONEY WITHOUT AN EXTRACTOR

It is advisable for a bee-keeper to procure the bee-appliances in sufficient time for his use so that he might not be inconvenienced at a time when these are most needed. A bee-keeper friend was put to great difficulty in extracting honey having failed to be equipped with an extractor. The flow came, the shallow combs were all full of honey, but he did not know how best to help himself without the extractor.

Somehow, he had an impression that if the shallow combs could be exposed to sun, the honey in the cells will thin out due to heat and trickle down. With this idea he set himself to work. He procured a suitable basin and tied a piece of cloth placed loosely over it. The shallow combs were then uncapped and placed on the said cloth. And in order to prevent the bees from being drawn to the honey, he covered the combs with another piece of cloth which he tied round the rim of the basin after it had been thoroughly stretched. The basin was then placed in the sun.

He waited for a few hours in the eager expectation of getting honey and then opened the vessel. But, to his utter disappointment he found that the combs had all sagged and bulged out on account of the intense.

heat of the sun. The combs and the honey in the cells all made a mess, only a negligible quantity of honey accumulating at the bottom. So, neither could he extract honey nor did he get back the combs in their original shape or in any usable form. He had no other recourse left but to squeeze out the honey for what it was worth.

In the absence of an extractor the following method may be applied to extract honey without injuring the comb :

Uncap the comb and remove the cappings from the uncapping tray. (Uncapping Tray—Fig. 87 ; for its

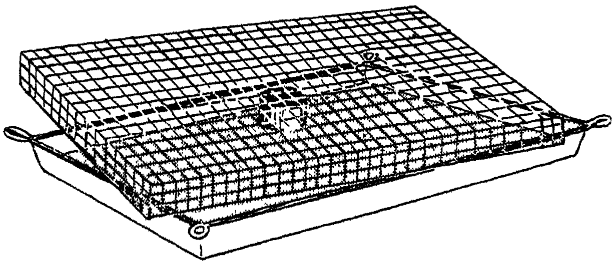


Fig. 87. Uncapping Tray.
The inner tray of wire-netting can be seen raised up.

details, see page 112). Place the uncapped comb on the inner wire-tray. Fasten the two sides of the frame with two pieces of strings encircling the outer tray (Fig. 88). Next, fasten four pieces of cords, 18" each, to the four loops at the four corners of the tray. Tie up the loose ends into a knot, and at the knot firmly tie another piece of cord 5 ft. in length.

Suspend the tray and firmly hold the other end of the long cord in the right hand. Now, start slowly

rotating the tray over the head in a vertical plane, with the comb laying on the wire-netting and tied on

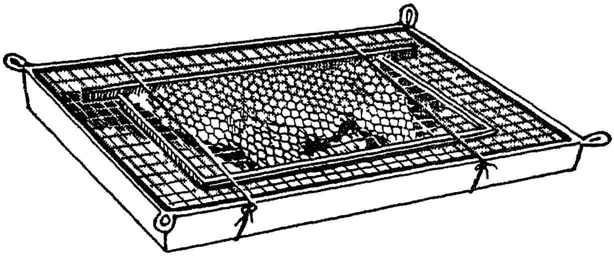


Fig. 88. Comb tied on to the tray.

to the tray (Fig. 89); then, hold the cord with both the hands and rotate the tray at a fair speed for a few seconds. The honey will thus be thrown out into the tray. Slow down, and finally stop rotating. Raise one corner of the tray up, and drain out the honey. When one side of the comb has thus been

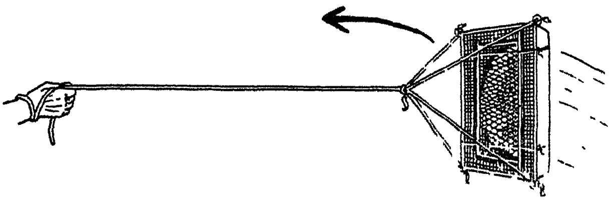


Fig. 89. Rotating the tray over the head.

extracted and the honey drained out, reverse the comb and extract the other side as before.

In the absence of an uncapping tray, as illustrated, a makeshift arrangement can be made with the help of any metallic tray. And, in place of the inner tray made of wire-netting, a few pieces of clean

split-bamboos of suitable size may be placed across the tray and the comb may then be tied on to it. A small bucket may also be conveniently used in the absence of a tray.

The process, as described above, is helpful in extracting a few combs occasionally. But no regular work is possible, and then, it requires a lot of strength to rotate the tray over the head at a fair speed. For continuous day to day work during the honey-flow season, one must get an extractor. (See 'Extraction of Honey', page 210).

CHAPTER XXXVIII

USE OF VEIL IN BEE-KEEPING

It is wrongly believed by some that for the protection of face from the bee-stings only the beginners require the bee-veil but the experienced bee-men do not. (For 'The Sting' see pages 28-33, and 143-145). The idea comes thus—If in handling the bees I happen to irritate or injure them, I get stings. If I take sufficient care not to mishandle them, I escape their attention. In a sense this is true. Bees generally do not thrust stings without provocation. But this provocation may not always be caused by the bee-keeper's carelessness or bad manipulation; for, the bees might already be in a state of provocation due to the attacks of the enemies e.g. the wasps, the hornets and the like, and to the attacks of robbers. Starvation may also be one of the reasons. (See Chapter - 13, 'Handling The Bees', page 175).

Before any attempt is made to open a hive, a look at the entrance will at once bring home to the trained eye whether the bees are already in an irritated state or they are in a sweet temper. When everything goes on apparently quite well, sometimes the guards at the entrance or some foragers coming from the field suddenly turn cross. Somehow, they grow suspicious, and this may be due to the presence of the

bee-keeper beside the hive. The bees are inclined to be irritated for other reasons also.

Apart from the sense of security so far as a beginner is concerned, an experienced bee-keeper would also require a bee-veil. When one has got to be with the bees for a long time at a stretch the veil becomes indispensable. When a colony must be examined and the bees seem to be excited, the veil will present itself to be a very seviceable appliance.

It may look well to do without a veil, and experience gained by practical work makes the bee-keeper bold. But over-confidence may put one to grief. Under no circumstances can bad manipulation of bees be approved, but there is no reason why one should feel it a reproach to use the veil. There is no good to run the risk, and meet friends and visitors with a swollen face when it can be easily avoided.

What matters is that the veil must be good. It should be of the best design, comfortable to wear, and provide a clear vision through it. It should be so made and fitted round the hat that the head can be moved in any direction with ease. It must be of black net and of sufficient width and length. And the net must be very fine but at the same time strong. (See 'Bee Veil', page 89).

A beginner may have one objection to the use of the veil in that it interferes to some extent with the free circulation of air. Compared with its advantages this can be safely ignored. And one gets accustomed to it when used regularly.

Subduing the Bees :—In the matter of handling bees, the use of smoke in subduing them has already been stated (pages 92-93, and page 177—'Subduing Bees'). It may be mentioned that *carbolic cloth* is also in use in order to subdue the bees. A piece of cloth, about one cubit wide and two feet long, is soaked in a weak solution of Carbolic Acid (say, 1% solution) and the excess of water squeezed out. After the roof is removed, the carbolic cloth is drawn over the frames and laid on them for a few minutes. It is then rolled off, and the combs are handled for examination. The pungent odour of Carbolic Acid throws the bees into confusion, and they gorge themselves with honey. The effect brought about is the same as that by smoking. (See 'How to Handle', page 176).

Curative Value of Bee-venom :—The use of bee-veil has been described above in connection with the protection that it gives against bee stings. Apart from the pain that the sting causes and the necessity of protection, there is the remedial value of the bee-venom which has been already referred to (pages 144-'45). In response to our request, Dr. Ramapati Mukherji, M. B., D. T. M., of Calcutta (page 219) who has been suffering from osteo-arthritis for a long time and who has recently been keeping bees to try the curative value of bee-venom by submitting himself to stings, writes :

> "It is difficult to assess the efficacy of the treatment. I am undoubtedly better. But I have been using other drugs as well. At first I was

using 10, 20, 30 bees daily, gradually increasing the number. At that time the treatment led to a slight aggravation of the pain in my joints followed by slight improvement. This is the usual result of all foreign protein injections, e. g. milk, vaccine and others. But this beneficent action seemed to pass away gradually. Then I stopped the treatment for treatment's sake. I am living continually in the same room with the bees and get two or three stings every day. Whether this has contributed to my gradual slow improvement, it is impossible to say. General medical opinion is that patients with radiating pain often get relief from the radiation of the pain by bee-venom injections. As I did not have any radiating pain, I am unable to give any personal opinion."

CHAPTER XXXIX

THE STANDARD NEWTON FRAME

The bee-keepers in the Hills use bigger frames, and they have their advantages. The hill-type of *Apis indica* is more industrious and a better honey gatherer. The queen, black in colour, is more prolific. (See page 38). These are some of the favourable points if we leave aside the question of better facilities in availing abundant trees, plants and shrubs producing the nectar.

The bee-keepers in the Plains have got to be satisfied with their type of queen, a brown one, though not equally prolific as the other, and the workers which are smaller in size. (See page 49, and also page 222 at the top). Various circumstances have made the bee-keepers in the Plains more calculating and perfectly practical. Instead of being disheartened they have adopted a frame which suited them most (page 80). And that frame is the Newton frame.

There may have been an erroneous belief in some of those who are better placed in the Hills, that the bee-keepers in the Plains are less painstaking or less qualified for the job because of their use of smaller frames. This belief seems to be due to their not being familiar with the conditions prevailing in the Plains. Honey is sweet, and the more the better. That led the bee-keepers in the Plains try brood-frames

larger in size to reap a better harvest. But experience led them finally to adopt the frame known as the 'Newton' frame, though smaller in size.

First Experiments in Trichinopoly and Rev. Newton :—A student of modern bee-keeping in India is familiar with the name of the Rev. L.V. Newton, S. J. of St. Joseph's College, Trichinopoly (page 78). The beginner comes to know him as soon as he gets acquainted with the smaller size of hives that are being used in the Plains of India. But very few persons know how the smaller brood-frames used in these hives came to be adopted and how it was left to Rev. Newton to make it widely known to the public for adoption by the apiarists that were to follow. The history of the uphill work carried out in the earlier stages of bee-keeping in India is yet to be written. And from this consideration a few words here about Rev. Newton and the frame that goes by his name will, we hope, not be out of place.

In the "Bee-keeping in South India" (Bulletin No. 37 of the Department of Agriculture, Madras), we first find reference to Rev. L. V. Newton's article on "The Domestication of the Indian Honey-bee", published in the *Agricultural Journal of India*, Vol. XII, 1917. Readers will find in the said article the earlier experiments in those days in domesticating *Apis indica* in artificial hives.

In that article, received for publication at the office of the said *Journal* on the 3rd September, 1916, the Rev. Newton wrote that Indian honey-bee was cultivated and observed in the gardens attached to

St. Joseph's College, Trichinopoly, for a period (with some slight interruptions) of over a quarter of a century. The Rev. J. Castets, S. J., began to make a study of the various Indian bees about the year 1890. At that time he tried successfully to domesticate the Rock Bee, the Little Bee and the Indian Bee (*Apis indica*), but soon came to the conclusion that the last one could be kept profitably in a hive. In these experiments he was greatly helped by the Rev. Father Bertram, S. J., the then Rector and Principal of the College, and the Rev. Newton was also lending an occasional hand. Later on, the Rev. Father Bertram had opportunity to continue his observations at Shembaganur, near Kodaikanal, on the Palni Hills. He also tried to introduce Italian bees. In the meantime, the Rev. Newton had continued to busy himself with the bees and made a careful study of their habits, manners and honey-yielding capacity in the garden of the College at Trichinopoly.

In this article he dealt with the economic value of the Indian Bee, the amount of honey it could be made to yield, and about the difficulties with wax moth. He gave a Table showing the amount of honey he had extracted during the six years 1911-'16, with every detail regarding the names of months as also the dates on which such extractions were done, using a simple extractor which he had constructed for his use. He described the methods of capturing wild colonies and housing the same in artificial hives, and discussed at length about the sizes of hives and frames suitable for *Apis indica* in the Plains.

Rev. Newton and Frame-size :—As to the exact circumstances in which the smaller frames came to be selected by the Rev. Newton, we quote the following from his above-mentioned article, under the sub-heading—"Hives and Frames" :

"The first point to be settled, before determining the size of the hive, is the size of the frames that are to hold the combs.

"It has been recommended for the sake of uniformity and other obvious advantages, that all bee-keepers should conform to the standard size of frame $14 \times 8\frac{1}{2}$ inches. Undoubtedly it is very desirable that in India, where bee-keeping as an industry can hardly be said to have begun as yet, a proper start should be made with standardized frames and hives. But the frame selected as standard should at the same time be the one best suited to the combs of *Apis indica,* and these, it must be remembered, are very much smaller than the combs of *A. mellifica.* It would seem to follow therefore that the frames of *A. indica* should be proportionately smaller than the European standard frame. The latter, in fact, appears to me altogether too large and quite unsuitable to our Indian bees.

"Some years ago the frames we used in our apiary were 12×6 inches in size, but even these, though smaller than the standard frame, were discarded as being too large. We now make use of two different sizes of frames, one for the brood chamber, $8 \times 5\frac{1}{2}$ inches, inside measurement, and the other for the honey-frames in the supers, $8 \times 2\frac{1}{2}$ inches. The

disadvantage in using very large frames, say, of the standard size, is that, as far as my experience goes, very few colonies of *A. indica*, will be found strong enough to cover more than 3 or 4 such frames, when first hived, and the result will be an amount of empty space in the hive, providing free lodging for the wax-moth and other pests. Another disadvantage is that the bees, unable to provide sufficient brood to fill such large frames, will store up honey in the same frame side by side with brood, making extraction impossible. It was by considerations such as these, and by observing the average proportion of brood-comb present in an ordinary good swarm, that Father Bertram in his experiments with bees in the hills finally fixed on the sizes of frames mentioned above, and these I afterwards adopted for all my hives.

"Placed side by side with standard frames, ours may appear absurdly small, but they have been found very practical, and for the present I think that it would be a mistake to try to make them larger, at least to any considerable extent. Bee-keeping in India is still in the experimental stage, and it is probable that, as our experience increases, we may come to develop stronger colonies. It may then be possible to fix on a frame slightly larger than the one mentioned above, but I do not think that will ever reach even approximately the standard frame size.

"To come to the hive itself, I have experimented and am still experimenting with hives of two

different sizes and find it hard to say which is to be preferred. There is something to be said in favour of each, and for the present I prefer to keep both kinds at hand, ready to use the one most suitable to each colony.

"Our earlier hives were built to contain 6 frames, $8 \times 5\frac{1}{2}$ inches in the brood chamber, and over this were piled up, as required, one, two, or three supers with frames $8 \times 2\frac{1}{2}$ inches for honey. But Father Bertram, who had to deal with good, strong colonies in his apiary in Shembaganur, urged on me the advantages of a larger hive with 8 or even 10 frames, and at last I made up my mind to try one with 8 frames. I found that change an improvement in several cases and have since used 8-frame hives for a number of colonies, with good results, though for others I have been obliged to keep to the 6-frame hive.

"There is always the same objection against overlarge hives as against large frames. Though they may do very well for big colonies, they increase the danger of the wax-moth if the hive starts being reduced through swarming, or any other cause. On several occasions to save a colony I have been obliged to re-transfer it from the 8-frame hive which must be mentioned, is that it tends to keep colonies strong and to strengthen them still more. It gives more space in the brood-chamber, and so encourages breeding. If the bees in a swarm are numerous and hard-working and the queen prolific, an 8-frame hive should be used. ..."

One misses here and elsewhere in the article the mention of the use of a Division Board by which the size of the brood chamber could have been easily adjusted to the size of the colony, without having taken recourse to re-transferring the combs from the 8-frame hive to a 6-frame one. It cannot be conceived that he did not know the use of the Dummy.

The portion of his article on the domestication of bees quoted above, shows how keenly did Rev. Newton feel the necessity of a standardized frame. He selected his own, put stress on further experiments, and pointed out the difficulties in adopting the British standard frame as one uniform standard size for India. But undoubtedly the proper start was made when he selected his own frame about 35 years ago. We find to-day that the smaller brood-frame has come to stay, and it has been universally adopted in the Plains. But the size has got to be standardized. Its necessity was keenly felt, as indicated by Rev. Newton when he first started his experiments. That necessity is still greater to-day as the number of bee-keepers is ever on the increase.

Other Standard Frames :—When a bee-keeper says that he uses the "British Standard" frame, or the "Langstroth" frame it reminds one the exact measurement of the frame that is in use. No bee-keeper can, at his sweet will, change the measurement of those frames, for, the names signify definite dimensions. The bee-keepers in other countries confine themselves to definite sizes as are indicated by the names of the frames.

The "British Standard", as the name indicates, is the recognized standard frame in England. It is very popular and quite large enough, though some use a larger size, e. g. the Langstroth. The Langstroth frame is the standard throughout the United States. And if any body wants a still larger size, he has the 'Modified Dadant' frame. (See 'Types of Hives and Sizes of Frames', pages 76-82; and for the 'Measurements' of frames, see pages 87-88). But the Newton frame which is so popular and so extensively used in India has no fixed measurement. (See 'The Newton Hive', page 78).

Various Sizes of Newton Frames : An Anomaly :— A frame of any dimension, only smaller than the British standard frame, is a 'Newton Frame'. And every bee-keeper has his own 'Newton' size. This may seem incongruous, but we think the frame has been correctly defined. We note below the measurements of a few Newton frames that are in use in some of the bee-keeping centres in India :

Place		*Size of Newton brood-frame*			
(1) Bari-Cuttack (Orissa)	···	8½ × 6¼	inches,	top-bar 9½	inches
(2) Coimbatore (Madras)	···	8½ × 6	,,	,, 10	,,
(3) Coonoor (Nilgiri)	···	8 × 5½	(inside)	,, 9¾	,,
(4) Coorg	···	8¾ × 6	inches,	top bar 10½	,,
(5) Maganvadi (Wardha, C.P.)		8½ × 6½	,,	,, 9½	,,
(6) Martandam (Travancore)		8 × 6	,,	,, 9½	,,

The above figures indicate end to end measurements except in places where they are specifically noted. These dimensions were collected in 1939. Allowing some alterations in size that might have

been made in the meantime, the position remains the same.

It would be misnaming if all these sizes and those others which are not included here are to be identified by one single name—the 'Newton' size. If there is anything in a name let that indicate only one definite size. In other words, let the size be standardized. That will make identification, reference and interchange easy.

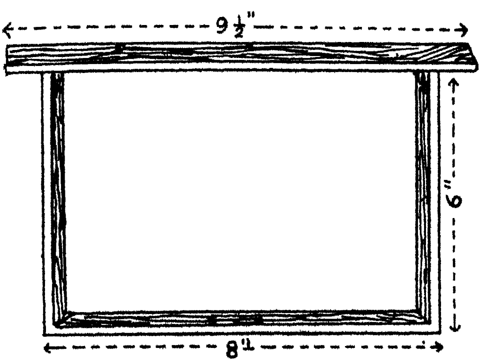
When once the size of the frame has been decided upon, any size of the hive accommodating between seven and twelve frames may be fixed, and the brood chamber can be adjusted with the Division Board according to the size of the colony. Three different sizes of hives may be made, accommodating 7, 9, and 12 frames, and the bee-keeper will then be free to make his choice according to suitability and the nectar-yielding capacity of any area. This will efficiently serve the requirements of all bee-keepers in the Plains without their taking recourse to increasing or decreasing the measurement of the frame to suit individual likes and dislikes.

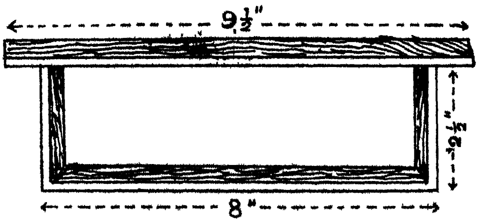
From the various measurements of the 'Newton' brood-frames quoted above, it will be noticed that 9½" top-bars are more commonly in use, as also depths measuring 6 inches. At the Sodepur Apiary the Martandam size is in use, e.g. top-bar 9½", bottom-bar 8", and depth 6" overall (see illustration, page 405).

'Standard' Newton Frame is a necessity :—As has already been explained, the choice for a 'standard' Newton frame for the whole of India has got to be

made. Small variations of a quarter inch, half an inch or three-fourth of an inch in measurement, as shown above, make no practical difference except confusing the beginner and making the exchange of combs and colonies between apiaries established in different districts and provinces difficult. The uniform use of a standard Newton frame will be decidedly advantageous in every respect. The situation is already in a complicated state and it must not be allowed to drift in this way any further. It is, therefore, high time for the bee-keepers in India to standardize the Newton brood-frame.

Newton Brood-frame : Sodepur Size.





Newton Shallow-frame : Sodepur Size.

The shallow frames also differ in size. The varying depths range between 2½ to 3½ inches and more. It is necessary to pay attention to this as well.

CHAPTER XL

CHEMICAL COMPOSITION OF HONEY

Nectar as collected by the bees by visiting the flowers is a solution of sugars. It is chiefly cane-sugar. As already stated, nectar undergoes chemical change while in the 'honey-sac' of the bee and in the comb, and is transformed into honey. (See 'What is Honey and How it is Made', page 1). The process of this conversion, though complex, is highly interesting. Nectar is collected from various classes of flowers, and it is for this that the chemical composition of honey varies to some extent between samples.

Sugars in Honey:— Honey mainly contains different sugars, e.g., Cane-sugar (Sucrose), Grape-sugar (Dextrose) and Fruit-sugar (Lævulose). These sugars in honey vary in proportion.

Cane or beet sugar is sucrose. When digested, sucrose changes into Dextrose and Lævulose. In honey we have a very small quantity of sucrose; predominant sugars being dextrose and lævulose. Honey is thus a predigested food. (See 'Nutritive Value of Honey', and 'Honey as a Daily Food', page 2).

The Work of Enzyme : Process of Inversion :— The above change of order in sucrose, in other words, this inversion of sucrose into dextrose and lævulose is

caused by what is called, 'Enzyme'. Here, this *enzyme* is 'Invertase' that splits cane-sugar. That, *enzyme* is a chemical or unorganised ferment as distinguished from Yeast and other living ferments, is the dictionary meaning. Invertase is known as a hydrolytic ferment or *enzyme*. There are many enzymes, and it is 'Diastase' that splits starch and converts it into sugar. Diastase occurs in leaves and in germinating grain.

There are enzymes in the human body. They have functions of their own. We have enzymes in our digestive system which help in the digestion and assimilation of the food that we take. The enzyme invertase is found in the body of the bee. The sucrose-content of nectar is inverted to a mixture of dextrose and læevulose by enzymes, principally invertase, secreted from glands in the head and thoracic region of the honey-bee. This explains the process of inversion.

Dextrose :—Dextrose is found in nature. It is widely distributed in plants, specially in the sweet-tasting parts, and in ripe fruit, where it is usually associated with both fruit and cane-sugar. It is present in ripe grapes, hence the name 'grape-sugar'.

Honey becomes opaque on granulation. These crystals in honey sometimes remain suspended giving it a frosty or a cloudy appearance, and, sometimes a solid look. Crystals also settle down at the bottom leaving a clear liquid-honey above. The fine crystals that are found thus suspended while honey is in the process of granulation, or found deposited at the bottom are crystals of dextrose.

Lævulose :—Lævulose is also found in nature. It occurs in plants and in fruits along with dextrose. Fruit-sugar, lævulose, is also called 'Fructose'.

Granulation :—Dextrose separates in honey slowly on standing in the form of crystals as stated above. Lævulose present in honey does not granulate, and is in excess of dextrose. It is believed that these two factors generally tend to retard the granulation of honey for an appreciable length of time.

There are some types of honey which begin to crystallise within four or five months of their extraction. Mustard honey, for example, granulates very quickly (page 201). In some cases, fermentation starts as soon as crystals begin to appear, and in some it is delayed for a considerable period. Some honey do not crystallise even on long standing.

Granulation and Fermentation :—When the honey granulates, it leaves the liquid thinner. The thinness in consistency, thus caused, tends the honey to ferment.

Aroma and Colour :—Honey varies according to the plants from which nectar has been obtained. The difference in the aromatic constituents alter the aroma and the taste of honey.

The colour of honey varies considerably from clear white to dark red or brown. It depends on the flowers that supply the nectar and on the blossoming season. It has been observed that, in the Plains, the colour deepens as the season advances. (See 'Pure and Fresh Honey', page 2, and 'The Honey Flow', page 206, first para).

The soil as also the plant play respective parts in the colour of honey so far as the nectar is concerned. And, the colour of honey bears a close relation to its mineral content. The darker the colour, the higher the mineral matter contained in the honey. (See 'Nutritive Value of Honey', page 2).

Then again, the colour of honey slowly undergoes change on standing. It gradually gets darker with age. Both heat and light affect the colour of honey. (Also see, 'Heating Honey', page 230).

Chemical Composition :—Nectar contains about 75 per cent. of water. The conversion of this nectar or its inversion into honey which begins while it is in the honey-sac of the bee, continues in the comb after it has been deposited in the cells where the honey ripens. In the process of ripening, the water is reduced from about 75 per cent. to about 20 per cent. (For the specific gravity of honey, see 'Density', page 231). The sucrose-content of nectar inverts to dextrose and lævulose. The main constituents of honey, therefore, are dextrose, lævulose and water, the other ingredients being Formic Acid, Proteins, Mineral Salts, Volatile Oils and some other substances. The mineral salts include among others, iron, calcium, magnesium and manganese.

Analysis of Indian Honey :—The composition of honey, as already stated, varies from sample to sample. The following extracts of the analyses of Indian honeys are given below :

(1) We quote here the composition of an average sample of cotton-honey of South India, being the

result of analysis made by the Government Agricultural Chemist, Coimbatore, Madras (Bulletin No. 37 on Bee-keeping, 1937, published by the Department of Agriculture, Madras, page 63) :

(1)	Moisture	14·89	per cent.
(2)	Reducing Sugars (Dextrose and Lævulose)	73·96	"
(3)	Sucrose	5·84	"
(4)	Ash	0·47	"

(2) Samples of honey collected from five different places in the Bombay Presidency, e. g. Belgaum, Mahabaleshwar, Malkapur (Kolhapur State), Panchgani and Taloda (West Khandesh), were analysed in the laboratory of the Agricultural Chemist to the Government, Poona (Bombay). The results obtained were published in the Poona Agricultural College Magazine (Vol. XXXI, No. 1, July 1939, pages 20-24). The average composition of these five different samples works out as under :

(1)	Moisture	19·27	per cent.
(2)	Dextrose	27·89	"
(3)	Lævulose	38·36	"
(4)	Sucrose	2·19	"
(5)	Total Ash	0·48	"

The English and American honeys also give very nearly similar results. The proportion of the lævulose-content in honey is always higher than dextrose. The high percentage of moisture in honey lowers its specific gravity. It shows the honey to have been insufficiently ripened. (As to the bad effects of unripe honey, see 'Density', page 231. Also see page 191,

second para). But there are some types of honey which are usually thin though extracted from combs which had been fully sealed. (See 'Moisture in Honey', page 415).

Adulteration of Honey :—High sucrose-content is objectionable. In natural honey sucrose rarely exceeds 6 per cent. The abnormally high percentage of sucrose creates doubt about the genuineness of the honey. It generally indicates adulteration with cane-sugar either by feeding sugar-syrup to the bees at the time of honey collection or adding thick syrup direct to honey. Sometimes honey is adulterated by adding commercial invert sugar and commercial glucose. Their presence in honey can be detected by analysis.

In India we have no regulation requiring what the standard of the average sample of honey should be. (As to the legal standard of honey in other countries, see Chapter-41).

CHAPTER XLI

LEGAL STANDARD OF HONEY

In India we have no statutory standard of honey. There are Food Acts in the different provinces for the prevention of adulteration of food. In the Municipal Acts of large cities there are provisions prohibiting the sale of adulterated or misbranded food. Honey, as a food, gets as much protection as laid down in such Acts, and no more.

Regarding the adulteration of food we find in Chapter I, Section 2, of the Bengal Food Adulteration Act, 1919 (as modified up to the 1st July, 1931) :

> "an article of food shall be deemed to be 'adulterated' if it has been mixed or packed with any other substance, or if any part of it has been abstracted so as in either case to affect injuriously its quality, substance or nature;"

Prohibition of sale, etc., is laid down in Chapter II, Section 5 *(1)*, as under :

> "No person shall, directly or indirectly, himself or by any other person on his behalf, sell to the prejudice of the purchaser any article of food which is not of the nature, substance or quality of the article demanded by such purchasers ; and no person shall, directly or indirectly, himself or by any other person on his behalf, manufacture for sale any article of food which is not of the nature,

substance or quality which it purports or is represented to be:

"Provided that an offence shall not be deemed to be committed under this section in the following cases, that is to say:—

"(*a*) where any matter or ingredient not injurious to health has been added to any article of food because the same is required for the production or preparation thereof as an article of commerce, in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight or measure of the article or to conceal the inferior quality thereof; or

"(*b*) where any article of food is unavoidably mixed with some extraneous matter in the process of collection or preparation; or (*c*)...."

Similar may be the provisions of the Food Act in other provinces too. In the very nature of things, when the squeezed-out honey has a ready market here, and when modern bee-keping has not established a firm footing in the land, we may not expect the promulgation of any law in the near future prescribing certain minimum standards of the purity of the honey. But discriminating consumers can help in protecting this growing bee-keeping industry and pushing the sale of pure honey produced in the modern apiaries.

And then, the bee-keepers themselves have a great deal to do. They have got to be alert, and establish the industry on a sound basis. It is for them to fix a standard of quality, and this will be advantageous both to the consumer and the producer. In the

meantime, we may look to the standard of honey that has been set up in other countries.

English Honey :—The Ministry of Agriculture and Fisheries, London, has set up the National Mark Scheme for Honey. It lays down among other things that the honey shall contain not less than 80 per cent. of total solids, and not more than 2·5 per cent. of sucrose. It shall be well-ripened and free from objectionable aromas, and from objectionable flavours due to overheating, fermentation, smoke and carbolic acid. Liquid honey shall have a specific gravity of not less than 1·415 at 60°F.

American Honey :—The standard of honey in the U. S. A. is that it should contain not more than 25 per cent. of water, not more than 8 per cent. of sucrose, and not more than ·25 per cent. of ash.

German Honey :—In Germany, the use of the word 'honey' was restricted to the sweet substance produced by the bees in their combs from nectar or from other sweet juice found in parts of living plants and taken up by them.

Pictures of honey-bees or similar insects, or pictures relating to bee-keeping could not be used on receptacles or labels used for artificial honey. And then, adulterated honey, deteriorated honey and artificial preparations of honey-like substances could not be described as 'honey'.

In the Netherlands :—Here the regulation was that in honey the total solids must not be less than 75 per cent., and the sucrose-content not higher than 5 per cent.

Moisture in Honey :—The moisture-content of honey allowed in foreign countries vary between 20 to 26 per cent. In Canada, France, and the United States the allowable maximum percentage is 25, and in Australia it is 26. (For the 'Chemical Composition of Honey', see page 406).

Purified Honey :—In the British Pharmacopœia, it is the purified honey (Mel Depuratum) which is exclusively official. It should have a specific gravity adjusted to 1·36. It has also to meet other specifications.

Narbonne Honey :—Narbonne, a town in Aude in the south coast of France on the Gulf of Lions, is famous for honey. The white, delicately-flavoured Narbonne honey is widely known in Europe and highly prized.

CHAPTER XLII

HONEY AND GLUCOSE

Hydrogen and Oxygen in the proportion to form water, combined with certain atoms of Carbon, form compound which is called hydrate of carbon or Carbohydrate. Carbohydrates are among the chief products of plant life.

Carbohydrates are divided into two groups, (1) Sugars, and (2) the Starches (and Celluloses). Their physical properties are different, but chemically they are closely related.

Sugar is formed in green leaves and in the stems of plants. Carbohydrates, such as sugars, are sweet and soluble in water, but starch is tasteless and insoluble in water. Sugars form crystals but the starch does not.

Sugar is the form in which carbohydrates circulate in the plants, and starch is the form in which they are stored up. In case of need, this stored carbohydrate —starch—changes into sugar by ferment, and the soluble sugar then circulates through the plants and serves as food. When a plant manufactures more carbohydrate than it needs, it is then only that the surplus is stored in the form of starch, for future use. Starch is an indispensable constituent of nearly all plants. It is found in their various parts and is stored in their seeds and tubers as a reserve from which

the shoots, seedlings and young plants get their nourishment.

The chief value of carbohydrates lies in their being the source of energy production. Human beings, in their turn, use this stored-up starch as their food. The chief sources of starch are rice, wheat, maize and potato. And as for natural sugars, we look to the juice from sugar-cane, various fruits and honey. This latter article, honey, is produced from nectar.

Nectar is the very essence of plants, secreted by the nectaries of flowers. It is the provision of Nature (see 'Pollination', page 20). In Sanskrit, nectar is called *Pushparas* or *Makaranda*.

Honey is produced from nectar, and so it is called *Pushparasodbhaba*. Being prepared by the bees, it is called *Makshik* and *Makshikabanta*. Bees are called *Madhukar*, for, they make honey.

Nectar of flowers, collected by the bees, undergoes chemical change. It splits or breaks up into a mixture of grape-sugar (Dextrose) and fruit-sugar (Læevulose), and transforms itself into honey in the bee-hive. (See 'Chemical Composition of Honey', page 406). In honey we find sugars in a natural state.

Of the two predominant sugars in honey, one, found crystallised in it, is the invert-sugar dextrose. The substance, commonly known as Glucose, is dextrose manufactured artificially. In Germany glucose is made from potato-starch, and in America the source is corn-starch.

Commercial glucose or *starch-sugar* is made by heating starch with dilute Sulphuric or Hydrochloric

Acid. Starch is mashed with water, and acid is added. It is then heated in autoclave under steam pressure, taken out and passed through other manufacturing processes. The liquid produced is decolourised by filtration through animal charcoal. It is evaporated in vacuum pans. Liquid glucose is thick and viscous. It is passed through other processes to crystallise.

Glucose so prepared artificially is a product which has only one sugar—dextrose. As to sweetness, it may be said that glucose is less sweet than cane-sugar. The lævulose-content of honey is comparatively much sweeter than dextrose. Honey contains more lævulose than dextrose. Therefore, honey ultimately stands sweeter than the ordinary cane-sugar. And then, glucose lacks in aroma and flavour which is so peculiar to honey. Glucose is used for the manufacture of beer. Distillers use it for making alcohol. It is also used as a sweetening material by confectioners.

Genuine honey is exclusively a bee-product, and the source of production is nectar from flowers. It is pure on account of honey being extracted and bees reared under modern scientific methods. With its two invert sugars, various mineral salts, other ingredients, aroma and flavour, honey stands supreme as a natural sweet and a predigested concentrated food.

It may be said that pure honey is a better stuff than glucose, from all points of consideration. And, of late, physicians too have taken to prescribing honey to patients.

CHAPTER XLIII

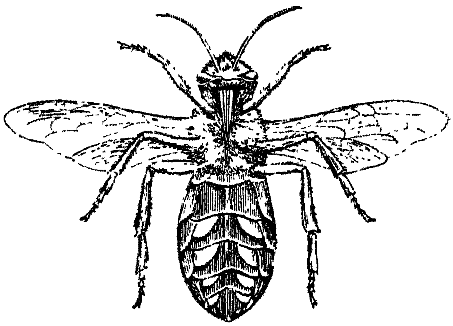
BEESWAX

Export Trade of Wax :—The dealers get the cakes and balls of crude, unrefined wax from those who collect the wild combs for honey. And, as has been said, wax has a ready market. The export of wax from India in 1905-'6 was 8,593 cwt., valued at Rs. 7,31,320/-. The major portion of export went from Bengal. And so far as Bengal was concerned, supplies were drawn by Calcutta from the Sunderbans, Chota Nagpur, Chittagong, Darjeeling, Bhutan and Nepal. The other provinces swelling the export figure were Assam, Bombay, Berar, Central Provinces, Madras, Punjab and Rajputana. The chief receiving centres in 1905-'6 were : Germany, United Kingdom, Belgium, Straits Settlements, United States, France and some other countries.—(Watt's Commercial Products of India).

The Pusa Bulletin No. 46, published in 1915 by the Agricultural Research Institute, gives the annual export value of beeswax as more than 7 lakhs of rupees. The Miscellaneous Bulletin No. 6 of the Imperial Council of Agricultural Research on Bee-keeping, which is the revised edition of the above Bulletin No. 46 of 1915, quotes the same figure in 1934. It seems, therefore, that the export trade of wax has remained the same during the last 30 years beginning from 1905. (See page 343).

Production of Wax by Bees :—It has already been said that the worker-bees secrete wax through wax-plates underneath the abdomen (page 28). It is being secreted by wax-glands on the underside of the abdomen of the workers, for which they require a temperature of about 98°F. (See '*functions of young bees*', page 326).

Bees consume food and generate heat. They raise the temperature by clustering and hanging in chains inside the hive (page 43). They consume about ten pounds o honey for the production of a pound of wax. The production of wax by the bees is, therefore, a costly affair.



Wax-scales can be seen on the abdomen of the bee.

Wax exudes in a liquid state into four pairs of pockets situated on the last four abdominal segments on the lower side, as illustrated here. It solidifies in coming in contact with air, in fine scales, about 1/16th inch in length and less than that in width. These scales are sometimes seen on the bottom-bars of frames and also on the floor board ; the author has noticed these scales particularly in the congested hives and hives having laying workers and defective queens.

Characteristics of Wax :—Beeswax is sticky to the feel. It is tasteless. It gives a pleasant smell of honey. It floats on water, and has a specific gravity between ·96 and ·97. It melts at a temperature between 63° and 64° C. (or 145·4 and 147·2 F.).

Conversion of Thermometer Readings :—For the same temperature let F and C denote the readings on the Fahrenheit and Centigrade scales respectively; then, $F=\frac{9}{5}C+32$; and $C=\frac{5}{9}(F-32)$.

Colours of Comb and Wax :—The colour of fresh comb varies and may be ranged as cocoanut-white, milk-white, light yellow and brown. At the beginning of the honey flow season, the colour of the newly-built combs is generally white. The colour depends on the variety of honey consumed by the bees. Old combs are dark in colour.

The colour of wax also varies from dull white and pale yellow to deeper shades. Wax of lighter colour fetches better value than that of deeper colour. (See 'Refining and Decolourising', page 428).

Uses of Wax in Hive :—The wax scales are pulled off by the bees by their feet, transferred to the mouth, masticated with the saliva, and with the mandibles series of cells are built that form the comb. Wax is also used by the bees to seal up the honey-cells and brood-cells. Cappings of brood-cells are made porous by the addition of pollen with wax. (See 'Uses of Wax', page 429).

Bee-keepers' Sources of Wax :—As has been said above, beeswax is a natural secretion from the body of the bees. It is secreted for their own use, the main

purpose being comb-building which ultimately goes to make their home. Wax employed in building the combs of a Newton hive, including that of the supers, weighs about a pound ; it means the consumption of about 10 lbs. of honey by the bees. So, the combs are costly and the bee-keepers cannot destroy the combs merely to get the wax.

Sources of wax open to the bee-keepers are the combs that are rendered useless on account of the ravages of wax moth and therefore discarded, the black combs that are worn out by continual brood-rearing, and the cells of which have been greatly reduced in size on account of the portions of cocoons left in the cells, as also by the skins cast by larvæ and have, therefore, become useless for further brood-rearing. And then, there are the broken pieces of combs, the brace combs, the cappings of the honey combs received while they are uncapped for the extraction of honey, odd bits of combs, scrappings, clippings of comb foundation, and such things that may accumulate from time to time. There are also the dark, damaged, ununiform and old combs that are rejected while capturing wild colonies (page 129). These are the materials from which wax may be rendered.

It goes without saying that all cappings and rejected combs to be rendered into wax should be made into small lumps or balls and kept in a closed box or a tin-pot as a protection against the attacks of wax moth, till a sufficient quantity has accumulated and the actual process of extraction is taken in hand. (See 'Rejected Combs', page 148).

It should be noted that combs used exclusively for the extraction of honey can be used over and over again for any number of years, for, they do not deteriorate thereby.

In modern bee-keeping, honey occupies the first place as an article of food, and wax is treated only as a by-product. Modern bee-keeping brings better value for honey to the bee-keeper. But in India, as at present, the bee hunters, it seems, secure the combs for wax alone, the honey to them is of secondary importance. The Forest Departments of the Provincial Governments lease out every year the right of collection of the wild combs for honey and wax from the reserved forests and get a good revenue.

Extraction of Wax :—Wax is known as *Mom*, *Modhushesh* (that which is left after the honey is extracted), *Modhuchhishta* (refuse matter left after the extraction of honey), *Siktha*, *Mayan*, *Moinam*. Wax may be extracted, as described below, by (1) the Solar Wax Extractor, (2) boiling the combs and odd bits in water, and by the use of (3) the Steam Wax Extractor :

(1) **The Solar Wax Extractor**—The very name of the extractor indicates that the extraction is entirely dependent on the sun for the heat. The solar wax extractor (Fig. 90) is a box with glass lid. It has two legs on one side, so that the box may be kept in a slanting position facing the sun. Inside the box there is a metal tray partitioned by a wire gauze. Bits of combs, cappings or burr combs to be rendered are

spread out on the tray. The extractor is then placed in the direct rays of the sun at a convenient place. The wax melts and runs down the tray leaving the refuse matter behind. The rays of the sun also tend to bleach the colour of the wax which may be considered as an additional advantage. These extractors are not well adapted for the old, black and tough combs, because extraction being partial, the refuse matter requires to be further treated.

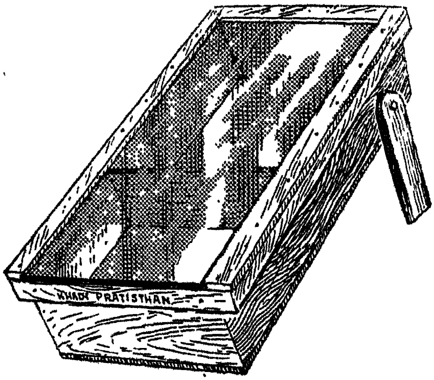


Fig. 90. Solar Wax Extractor.

(2) **Extraction by Boiling**—In the old process, the extraction of wax is done by boiling the combs in water for sometime. The hot mass is then poured out on a piece of cloth placed over a suitable vessel. The water and the melted wax pass through the cloth, and any wax left in the refuse matter is squeezed out at once while hot. The liquid wax floats on water, and hardens when the water cools down. The wax is then taken out, re-melted and moulded into cakes.

The above process of extraction is unsatisfactory. The broken-up combs float on water and it makes the boiling difficult, and when the hot mass is poured out on the cloth, some of the liquid wax hardens on the

combs. Squeezing the hot mass is also a difficult operation. And then, some wax sticks to the cloth.

This boiling water process may be greatly improved upon in the following way to yield satisfactory results. For the extraction, break the combs into small pieces. The pressed balls, the lumps of cappings and the rejected combs should also be broken up. Place these on a piece of mosquito netting, say, a cubit square. Tie up the ends of the netting, and fasten the bundle tightly with a string. Next, tie up the bundle to a piece of brick about 5″ × 5″ × 3″ or to a stone or any other suitable weight. Now, place this bundle in an ordinary tin canister. Let the piece of brick or stone rest on the bottom of the vessel and above it the bundle tied to it. Fill the vessel with sufficient clean water covering the bundle. The bundle is to be tied to the weight in order to prevent it from floating on water.

Let the bundle be soaked in water for about twenty-four hours ; drain out the water and wash the bundle in the canister by two further changes of fresh water. Pour water finally into the vessel and see that the bundle rests about three inches below the water level. Now, place the vessel on fire and raise the water to boiling. Keep the water boiling on a slow fire for about an hour or for so long a period as that would ensure the melting of the wax completely. It should not be overboiled or briskly boiled. Keep the vessel covered with a lid while boiling is going on.

The wax will melt, pass through the netting and float on the surface of the boiling water in a liquid

state. Remove the vessel from the fire after one hour or so. Remove the cover and see that the bundle is well under water. Allow the vessel to stand thus overnight. Next morning a thick or a thin sheet of clear solid wax will be seen floating on water. Push down the blade of a knife at any point between the wax and the wall of the vessel, and pass the blade round the sheet of wax. Remove the sheet from the vessel.

A layer of soft and spongy dross will be found at the bottom of the sheet. It is chiefly emulsified wax mixed with some impurities. Scrape off all dross and dirt and wash the wax-sheet in running water. Wax of beautiful colour will thus be got by the boiling water process.

In rendering wax by boiling, a clean kerosene tin will serve the purpose well as already stated. Iron vessel affects the colour of the wax. (Regarding water, see 'Use Soft Water', page 428, and for refining wax, see 'Refining and Decolourising', page 428).

Now, take out and open the treated bundle. It will be found to contain only the black refuse matters. Collect the few yellow particles of wax that may be found here and there in the refuse matter or adhering to the net. The refuse matters may be thrown into a manure pit, and where the quantity is small, it may be kept in a drum from time to time and covered with three to six inches of earth, to be used as manure when properly decomposed. The netting should be washed and dried. The same piece of netting may be used for a number of times.

Whether the quantity of material to be extracted is large or small, the boiling water process is easy, efficient, and most suitable for all practical purposes. And it may not be at all necessary to go into the expense of purchasing a steam wax extractor where only a small quantity has to be treated.

(3) **The Steam Wax Extractor**—This extractor consists of two parts. There is the lower pan which holds water, and above it stands a tin cylinder or steam jacket which is the upper part, having a dish inside, communicating with an outlet. The dish is about 1½″ deep. A perforated tin basket stands on legs about an inch from the bottom of the dish. Between the dish and the jacket there is space to allow the steam to pass up to the basket, and there is a short tube in the centre of the dish to act in the same way.

In working the extractor, the basket is placed inside the jacket after being filled with broken combs, cappings or whatever materials from which wax is to be rendered. The jacket, with the basket and combs, is then placed on the bottom pan which has previously been half-filled with water. The jacket fits closely on the bottom pan. The top is also covered with a closely fitting lid. The extractor is then placed on the fire.

The water boils, steam rises up, passes through the perforated walls of the basket and melts the wax of the materials placed inside the basket The liquid wax oozes through on to the dish and runs out through the spout into a basin containing hot water that has been placed below the spout to receive the liquid wax

coming out. The materials from which wax is to be extracted should be first soaked in water overnight, washed and all water drained out before these are placed in the basket. There are different sizes of extractors varying between 9 inches high and 6 inches in diameter to 26 inches high and a foot in diameter.

Treat the old and new combs separately :—Instead of rendering the old and new combs, the cell cappings and odd bits all in one lot, it would be better to treat them separately according to their colour. For, the cappings and bits of fresh combs will yield wax of lighter colour and the light-coloured wax fetches better price than the darker wax from the old black combs. The latter generally contain little wax and more of refuse matter.

Use Soft Water :—It is advisable to use soft water in order to extract wax by boiling, for, hard water affects the colour of the wax. Rain water is recommended. Hard water may be boiled separately in a vessel, allowed to settle, and the clear water may then be used for boiling out the combs.

Refining and Decolourising :—For refining the sheet or the cake of wax, it should be broken up and re-melted as before if any impurity is found, and this time instead of a mosquito netting, a little more closely woven piece of cloth should be used. The wax may also be re-melted on water bath, strained through a fine cloth, allowed to solidify in an enamelled cup or any other suitable vessel, containing a very small quantity of hot water, the sides of the vessel having been slightly oiled to keep wax from adhering to the walls.

Allow the wax to cool slowly. Rapid cooling produces cracks in the wax cake.

Wax may be bleached with the help of air and sunlight, for which it has to be cut up into thin slices or made into thin sheets and broken to pieces, and then kept exposed for days together. The slices should have to be turned frequently. The sun-bleaching process is slow. It depends on the surface of the wax exposed to air and also on the intensity of light.

Wax of darker colour may be improved by treating it with a small quantity of Sulphuric Acid added to boiling water in which it should be re-melted. After boiling and stirring the wax for sometime, it should be allowed to cool down slowly. An enamelled vessel should be used while treating with acidulated water and the proportion of acid should be half an ounce to a gallon of water. The proportion of acid may be slightly increased if necessary. It would be unwise to go in for bleaching by acid without being properly equipped. There are other chemical processes for bleaching wax.

Wax Moulds:—Wax may be remelted and poured into suitable metal moulds to weigh one, two or four ounces of wax or poured into any other covenient sizes. Moulds should be kept wet with cold water. Wooden wax-moulds to get cakes of any size may be made easily. Wooden moulds should be soaked in cold water overnight before use. Wax may also be cast into split bamboo-moulds.

Uses of Wax :—Beeswax is used by silver and goldsmiths. It is also used by brass and copper-smiths (page 368). There is a demand for candles made of

beeswax. Wax is used in *Batik-Printing* on calico and leather. Shoe-makers and cobblers use it. In repairing the shoes, the wax-touch given to the twisted thread by the cobblers is a common sight.

Beeswax is commercially used in making boot-polishes, floor-polishes and varnishes. It is used in insulating some of the electrical goods. Cabinet-makers use *Mom-turpin* which fills the pores of wood and makes it non-absorbent to water.

Refined wax is used for the preparation of ointments and cosmetics. It is used in making anatomical and other models. In bee-keeping, it is used for the manufacture of comb-foundation.

Adulteration of Wax:— Beeswax is generally adulterated by the addition of paraffin-wax, mineral matters and other substances. Pure beeswax is completely soluble in turpentine. To test it, take a small quantity of wax in a test tube, melt it over a spirit lamp and while it is cooling, add some turpentine and stir well. A turbid solution or a solution throwing a deposit will indicate the presence of adulterants.

BIBLIOGRAPHY

The following are some of the books relating to honey and honey-bee which the author has had the opportunity of going through :

(I) Indian Publications *

(1) A Brief Memorandum on Bee-keeping in Travancore (1935), by C. R. Thompson, Trivandrum.

(2) A Guide to Successful Bee-keeping in the Hill Districts of Northern India (1916), by F. S. Cousins, Lieut. (Retired) : Issued under the authority of the Director of Agriculture and Industries, Punjab. (Superintendent, Government Printing Lahore, Punjab).

(3) A Handbook of Bee-keeping for India, by J. C. Douglas, India Government Telegraph Department ; published with the sanction of the Revenue and Agricultural Department of the Government of India, (Calcutta, 1884). The book is out of print. There may be a few copies in the Government libraries in the provinces. One copy is in the Imperial Library, Calcutta.

(4) Bee-keeping (1936), by C. C. Ghosh ; it being the Miscellaneous Bulletin No. 6 of the Imperial Council of Agricultural Research, Delhi.

(5) Bee-keeping (1939), by S. M. Chitre ; published by the All-India Village Industries Association, Maganvadi, Wardha, C. P.

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* For the Indian Periodical, see page 436, and for Foreign Publications, see page 434.

(6) Bee-keeping and Honey Gathering (1938), by M. Chakravarthi Nainar; Cottage Industries Publishing House, Kolapalur, North Arcot.

(7) Bee-keeping for Beginners (1938), by T. V. Subramaniam. This is the Entomological Series Bulletin No. 10 (Revised) of the Department of Agriculture, Mysore State, Bangalore.

(8) Bee-keeping in South India (Revised Edition, 1937), by S. Ramchandran. This is the Bulletin No. 37 of the Department of Agriculture, Madras; printed by the Superintendent, Government Press, Madras.

(9) Bee-keeping in the Punjab (1940), by Khan A. Rahman, and Sardar Singh; published by the Department of Agriculture, Punjab; (Superintendent Government Printing, Lahore, Punjab).

(10) Bhupen Series of Pamphlets on "Bee-keeping in India": Pamphlet No. 1, 'Prospects' (1937); No. 2, 'First Steps' (1937); No. 3, 'What Others Are Doing' (1938); No. 4, 'The Bee Hive' (1938); No. 5, 'Past, Present and Future' (1944); No. 6, 'Forty Questions Answered' (1944); No. 7. 'Elementary Practical Guide' (1944); published by Bhupen Apiaries (Himalayas), Ramgarh (Naini Tal, U. P.).

(11) Collection of Papers on Bee-keeping in India; published under the orders of the Government of India, in the Revenue and Agricultural Department (Calcutta, 1883). The book is out of print. There may be a few copies in the Government libraries in the provinces. There is one copy in the Imperial Library, Calcutta.

(12) Experiments in Bee-culture (1938), by S. R. Narayana Ayyar, Coonoor (Nilgiri).

(13) Hand Book on Bee Culture (1938), by John Dasiah, Secretary, Y. M. C. A. Rural Demonstration Centre, Martandam (South Travancore).

(14) The Domestication of the Indian Honey-bee, by Rev. L. V. Newton, S. J.; published in the *Agricultural Journal of India*, Vol. XII, 1917, pp. 44-57. The *Journal* may be available in different public libraries. There is one copy in the Commercial Library, Calcutta.

(15) *Madhumakshika O Tahar Palan* (1941, in Bengalee), by Protap Chandra Dutt; published by J. C. Dutt, 121, Rashbehari Avenue. Ballygunj, Calcutta.

(16) *Madhumakshi-Palan* (1942, in Hindi), by Dayaram Jugran; published by Bignan Parishad, Allahabad.

(17) *Moumachhi Palan* (1918, in Bengalee), by C. C. Ghosh; written after his "Bee-keeping" in English which was the Bulletin No. 46 (1915) of the Agricultural Research Institute, Pusa. The book is out of print. One copy is in the Bangiya Sahitya Parishat Library, Calcutta.

(18) *Moumachhir Katha* (1939, in Bengalee), by Rakhaldas Chakravarty, Dinajpur, Bengal.

(19) *Ashtanga Hridayam*, by Vagbhata: A compendium of the Hindu System of Medicine; (*Sutrasthanam*, 5th Chapter, *Madhugunah*, 53-56).

(20) *Bhavaprakasha,* by Bhavamishra: An encyclopaedia of Hindu Medicine; (Part I, Chapter-22, *Madhubargah,* 1-28).

(21) *Charaka-Sanhita,* by Agnibesha, revised by Charaka: A work on the System of Hindu Medicine; *(Sutrasthanam,* Chapter-27, *Ikshubargah,* 48-49. Also *Chikitsasthanam,* Chapter-23, effects of bee-stings, 39).

(22) *Sushruta-Sanhita,* by Sushruta: A well-known work on the Ayurvedic System of Medicine; *(Sutrasthanam,* Chapter-45, *Madhubargah,* 118-136; also *Kalpasthanam,* Chapter-8, for the description of bees—*Makshikabibaranam).*

(II) Foreign Publications

(1) A B C and X Y Z of Bee Culture (1935), by A. I. and E. R. Root: A Cyclopedia of Everything Pertaining to the care of the Honeybee; (an American publication).

(2) Ants, Bees, and Wasps (1882), by Lord Avebury (Sir John Lubbock): A record of observations on the habits of the Social Hymenoptera.

(3) Bee-keeper's Vade-mecum (1920), by Henry Geary.

(4) Bee-keeping (1938), Bulletin No. 9 of the Ministry of Agriculture and Fisheries, London.

(5) Bee-keeping For All (1939), by Tickner Edwardes: A Manual of Honey-Craft.

(6) Bee-keeping Up-to-date (1936), by A.B. Flower.

(7) Bee Matters and Beemasters, by Herbert Mace.

(8) Better Bee-keeping or How We Made Bees Pay (1936), by D. F. Rankin, (U. S. A.).

(9) Bees and Bee-keeping (1886), by Frank R. Cheshire.

(10) Common Sense Bee-keeping, by M. M. Hooper.

(11) Honeycraft : In Theory and Practice (1931), by J. A. Lawson.

(12) Modern Bee-keeping (1933), by Herbert Mace.

(13) Practical Bee-breeding (1928), by A. Gilman.

(14) Practical Bee-keeping and Honey Production, by D. T. Macfie.

(15) Report on the Marketing of Honey and Beeswax in England and Wales (1931) ; it is the Economic Series Report No. 28 of the Ministry of Agriculture and Fisheries, London.

(16) Starting Right With Bees or Beginner's Hand Book on Bees (1937), published by The A. I. Root Company, Medina, Ohio.

(17) Swarming : Its Control and Prevention (1936), by L. E. Snelgrove.

(18) The Book of Bee-keeping : A Practical and Complete Manual on the Proper Management of Bees (seventh edition), by W. B. Webster.

(19) The Diseases of Bees : Their Signs, Causes and Treatment ; published by The Apis Club.

(20) The Life of the Bee, by Maurice Maeterlinck.

(21) The Practical Bee Guide : A Manual of Modern Bee-keeping (1936), by The Rev. J. G. Digges.

(III) Indian, Periodical

The Indian Bee Journal (1939-'44, Vols. I, II, III, IV, V, and VI): It is a two-monthly periodical published by the All-India Bee-keepers' Association, from Ramgarh, Dist. Naini Tal, U. P.

The All-India Bee-keepers' Association was founded in 1938. Mr. R. N. Muttoo is the Honorary Editor of the *Journal* and Hony. Genl. Secretary to the Association. The *Journal* is free to the members of the Association, the membership fee for the latter being Rs. 5/- per annum and rupee one as admission fee. The annual subscription for the *Journal* is Rs. 3/-. (For more about bee-journals, see page 332).

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Date of issue.	Date of issue.	Date of issue.
8.7.48		
7.1.53		
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21/4/62		